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A study, at the University of Chicago, of 177 unselected children--an entire first-grade class of normal intelligence, of common ethnic background, and within 6 months of their sixth birthday--was made to determine (1) whether those children with speech inaccuracies consistent enough to qualify them for speech therapy would achieve in their school subjects as well as children having no speech inaccuracies, (2) whether students receiving speech therapy (offered to half of the speech inaccuracy group) improved their school achievement or their articulation accuracy acquisition more than those not receiving therapy; and (3) whether a significant relationship existed between perceptual-modality factors and either school achievement or articulation. The study revealed no difference in school achievement between children who were considered to be in need of speech therapy and those who were not, no difference in school achievement whether a child had therapy or not, and no difference in improvement in articulation whether a child had speech therapy or not. A low but statistically significant relationship was found between the perceptual abilities and both articulation and school achievement. (Author/LH)

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July 1967

U.S. DEPARTMENT OF
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SPEECH AND LANGUAGE RESEARCH LABORATORY

THE UNIVERSITY OF CHICAGO

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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Project Number 2225

Contract Number 4 10 006

Joseph M. Wepman
Anne S. Morency

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The research reported herein was performed pursuant to a contract with the Office of Education, U. S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

The University of Chicago

Chicago, Illinois

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Joseph M. Wepman

Anne S. Morency

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CHAPTER I

INTRODUCTION

In recent years there has been a notable increase in the attention being paid in the primary grades to children with any sort of learning problem. This trend can clearly be seen in the present concern over early recognition of specific learning disabilities, the identification of children as "minimally brain impaired", in some of the new teaching methodologies in the language arts and in reading. One of the current reflections of this emphasis on early problems is the effort to provide speech correction for children in the early school years whenever any deficit in articulatory accuracy is found.

Our interest in the combined area of articulation accuracy and school achievement arose from extensive experience in a large urban speech and language clinic. The problems of both differential diagnosis of the cause of articulatory disorders and the need to provide recommendations for therapy were constantly being faced. This sort of confrontation led to the recognition of a variety of problems. Many documented instances were called to our attention, for example, in which schools were failing to promote some children within the early elementary grades if they did not speak accurately. A fundamental question that presented itself--is there a demonstrable relationship between articulatory accuracy and school achievement--was unanswered in the literature.

Also, in common with others in the field of speech pathology, our clinic had no answer, at least with empirical evidence to support it, to the question of whether speech therapy for children with articulatory inaccuracy in the early elementary grades was necessary. In other words, there remained the compelling question--might not many children do as well in attaining speech accuracy without special therapy and all of the concurrent psychological problems of being considered 'handicapped' or 'speech defective'.

Our interest in the cause of articulatory problems led to an exploration of some of the factors underlying learning. This in turn, as is shown later, led to an operational paradigm for learning which, it is believed, helps to explain why some children learn to learn differently than others.

What seemed to be sorely needed was an empirically documented philosophy of special education and remedial therapeutic programs which would maximize the potential of the children and which educators, remedial and otherwise, could turn to as a basis for action. Problems in the area of initial learning are invariably compounded by the fact that children in the early grades of school are at an age when developmental sequences, modality-bound perceptual factors, and conceptual states are so intermingled in the learning act that clear patterns of causality are difficult to determine. Meaningful interrelationships between these factors in the acquisition of speech, reading, spelling--in fact between all of the elements of early school achievement--need to be understood in the normal or unimpaired school populations. From such a background of data, the source of some of the difficulty in learning, it was felt, might be made more explicit and the direction and timing of remedial programs made more significant.

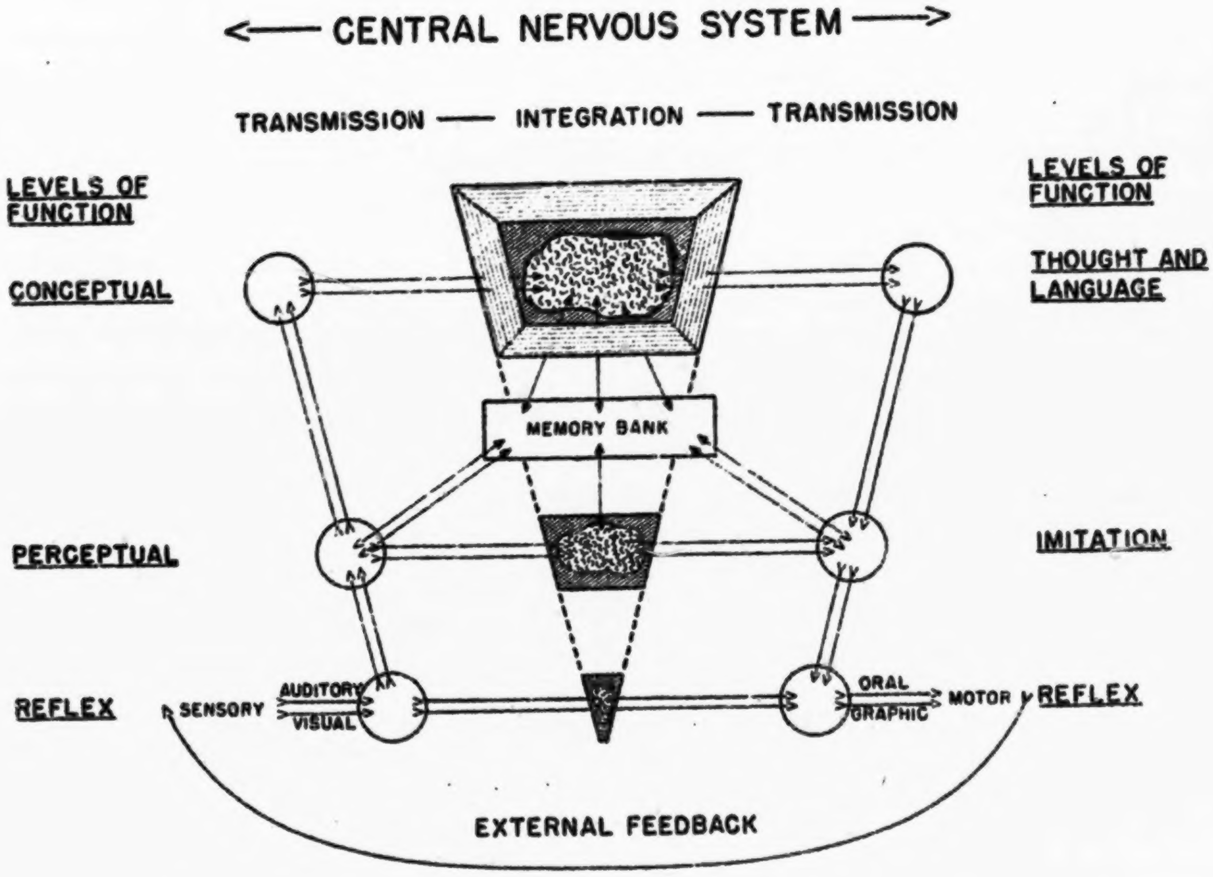
The present inquiry was structured around the framework of a concept concerning the acquisition of speech and language frequently referred to as the perceptual-modality paradigm (52, 56, 58). Earlier studies by the principal investigator had shown a consistently significant relationship between auditory discrimination (a perceptual function) and speech and reading (conceptual acts) (53, 54). Studies of language disability following cerebral insult had demonstrated the tendency for individual modalities to be affected differentially (55). More recently the present investigators have shown the identification of a pattern of articulatory inaccuracy which seems to be based upon developmental rather than pathological factors (57, 31).

The underlying theme of all of these previous studies had been in the direction of defining the unique modality-bound nature of all sensory input signals and all motor output patterns and the increasing levels of complexity of function--from perceptual to conceptual levels. These increasing levels, it is held, provide the essential bases for acquiring the initial stages of language in any form, be it speech, reading or specific aspects of school achievement. Figure 1 presents the operational paradigm introducing the concept and emphasizing the need for consideration of both the modalities used and the stages of learning in the developmental processes of children.

Figure 1

The model illustrates how the precondition for the development of conceptual symbolic verbal behavior exists at the pre-operational, pre-linguistic perceptual level. It is held that the alphabets of sounds and letters are learned and their interrelations established at this level. For Piaget, in Flavell (17), Kohlberg (26) and others, this would be the sensory-motor level of attainment. Only with adequate development of the auditory modality at the perceptual level, it is held, will adequate articulation develop, while only with adequate development of the visual modality will adequate reading ensue at the initial stages of learning at least. When either perceptual modality is undeveloped, inadequacies in learning will become apparent. As a modality develops in its capacity to discriminate, recall, and sequence the data it processes, however, and the ability to interrelate processed data from the various modalities develops, the apparent inadequacies will tend to disappear, all other factors being equal.

Figure 1.


CENTRAL NERVOUS SYSTEM
TRANSMISSION — INTEGRATION — TRANSMISSION
LEVELS OF FUNCTION
CONCEPTUAL
PERCEPTUAL
REFLEX
LEVELS OF FUNCTION
THOUGHT AND LANGUAGE
IMITATION
REFLEX
MEMORY BANK
SENSORY
AUDITORY
VISUAL
ORAL
GRAPHIC
MOTOR
EXTERNAL FEEDBACK

AN OPERATIONAL DIAGRAM OF THE LEVELS OF FUNCTION IN THE CNS

This operational description of the learning process led directly to certain aspects of the present study. It provided the theoretical framework upon which the research design was built, espcially in the area of assessment of perceptual function and the relationships of specific modality learning to speech and reading achievement.

While it may seem that the investigators have overemphasized the perceptual features of learning at the expense of the cognitive/conceptual levels this is not the case. Stress is placed on the acquisition of pre-cognitive sensory-motor learning to indicate the belief that this is a necessary precursor to cognitive/conceptual learning in the normal development of children. The avoidance of this level by so many students of early learning in children, it is believed, has led to the educational impasse of providing inadequate methods for so many school children. The overemphasis is meant to bring into proper perspective what is held to be an essential stage of learning, a stage often overlooked in the study of the developmental process of school age children. (For a more complete exposition of the perceptual modality construct in learning, see Appendix C.)

Related Research

In addition to the clinical observations and the theoretical construct of learning discussed previously, earlier research reported by the present investigators as well as research reported by others influenced the selection of the parameters of the present study.

In the area of articulation, recent research from this laboratory generally confirmed the fact that children between the ages of 5 and 9 who show inaccurate articulation have discernibly different patterns of errors depending upon the etiology of their disorder (57). By far the largest single group appearing in an average schoolroom, a group representing approximately 25 percent of the total first grade enrollment, presented a profile of sound errors that had no apparent or discoverable pathological cause. The speech inaccuracy that falls into this category is generally labelled functional in speech texts (49). Through the years, much of the research on articulation has focused on methods of predicting which of the children who have such functional articulation inaccuracy would outgrow their difficulty and which would not.

Carter and Buck (10) made a study of prognosis in articulatory disorders. Their prognosis was based on the child's ability to modify his responses upon stimulation. Steer and Drexler (44) administered an articulation test at the beginning and at the end of a specified period and noted how much improvement had occurred during the normal course of events. Spriesterback and Curtis (43) emphasized the importance of consistency of articulation errors. Templin (46), Van Hattum (48) and Roe and Milisen (40) approached the subject by comparing proficiency in the production of consonants with a developmental norm as the measure of expectancy of articulatory development.

A discussion by seven authorities in speech pathology reported in the Journal of Speech and Hearing Disorders (1) under the title, "A Controversial Issue: Case Selection in Public Schools", led to as many different opinions. All of the opinions were based on extensive experience and various research findings. The discussion centered on methods of identifying articulatory inaccuracies in children and determining whether correction was needed or desirable for each child, and if so, what kind and how much.

The present writers have long felt that the body of research dealing with these issues has lacked some vital elements which could contribute significantly to its explanatory value. Cross-sectional and short-term longitudinal studies of functional articulatory inadequacies are by definition incapable of answering some highly relevant questions and therefore require much inference for interpretation. For example, one outstanding characteristic of functional articulatory inadequacy is the dramatic decrease in the incidence of the problem with progression in age, particularly during the first three years of school (31, 38, 45).

One interpretation of the decrease in the incidence of these functional articulation problems with age--an interpretation derived from the evidence and therefore one that does not have to be inferred--strongly points to the conclusion that speech is acquired in a generally predictable developmental progression. This interpretation requires the consideration of individual differences in the development of the various underlying perceptual and motor factors, as well as differences in the developmental levels of independent pathways or modalities of learning (58). These differences account for the apparently wide age-range that exists for the acquisition of correct articulation. This approach leads in turn to the concept of age-appropriate speech accuracy (in contrast to functional articulation defect) and to the desirability of a broad revision of current thinking on what might be considered appropriate and inappropriate articulation during early childhood.

A second characteristic of non-pathological speech inaccuracy relates to the sounds on which errors are made. A study reported earlier (31) showed that error profiles of children, ages 5 through 9, whose articulation inaccuracy was non-pathological, consisted of substitutions and distortions on the last ten consonant sounds acquired by all children according to Templin (45). It was postulated from this that children whose errors were solely contained among these last ten sounds might be considered developmentally delayed in acquiring perfect articulation. Such errors in articulation, then, in light of developmental norms, it was held, would be considered as age-appropriate. In the present research the noted emphasis on 'functional' speech problems was redirected to an emphasis on the developmental nature of speech sound acquisition and age-appropriate speech.

Studies dealing with auditory discrimination are among those which directly relate to the modality-perceptual factors. This ability to distinguish fine differences in speech sounds is considered to be one of the several components contributing to development of the auditory modality. It has been widely studied relative to articulation (51), reading and spelling (32) in cross-sectional or short-term longitudinal studies. It can be concluded from these studies that: 1) there is a consistent increase in sound discrimination ability with age; 2) children vary in the rate of development of auditory discrimination; 3) the development of auditory discrimination has not reached fruition in some children until their ninth year.

Similarly, auditory memory, a second component of the perceptual auditory modality, has been widely studied. This factor refers to the ability of an individual to reproduce sounds in their original order immediately after presentation as a series of discrete stimuli (7). According to the literature, auditory memory span seems to develop naturally with age regardless of whether the materials used are nonsense syllables, letters, digits, sentences or related words. The studies vary widely as to the age of maturity, having an upward limit of 10 to 12 years (2, 29). Results that are reported differentiating perceptual from conceptual memory indicate that the former produces shorter spans with a smaller increase in ability with age than those spans produced by meaningful materials. Even though the studies that have related auditory memory to reading ability have not interpreted their data in the same framework as the present inquiry, that is, they have not distinguished between perceptual and conceptual memory, positive relationships have been reported (35, 39). Visual perceptual tasks that have been studied widely relative to development and learning in children generally utilize a motor task in addition to the visual behavior (3, 18). A recently published study by Birch and Lefford (6) has reported the development of visual control of motor activity. The first level in their hypothesized hierarchical organization is that of visual recognition ability. The second and third levels are visual analysis and visual synthesis. It is recognized in the literature that the task of visual discrimination is the earliest to be developed and the least affected by neurological damage (5, 50). Severely brain injured children (9) and adults (8), as well as children with significant degrees of mental subnormality (5) appear to be capable of making gross discriminations among visual figures. However, it has been firmly established that visual discrimination is developmentally acquired. According to the Birch and Lefford study (6): 1) By age 5, normal children have a high ability to discriminate among simple plane figures; 2) Errors made in the discrimination of such figures at ages 5-7 most frequently reflected the failure to utilize the spatial orientation of the figure or its properties of axial symmetry as discriminanda; 3) Errors of these two types fell with age and occurred infrequently by age 9.

Past inquiry relating speech, language, reading and spelling difficulties has taken a number of different forms. Language acquisition and articulation accuracy are usually related to learning by the auditory modality while reading and spelling problems have been studied with regard to both auditory and visual learning. No other studies known to the investigators have explored the particular objectives undertaken by the present study. This is because the method of identifying the experimental populations--by defining the developmental aspects as they pertain to speech inaccuracy--has just recently been developed. Also, the present investigation approaches the problem through a longitudinal study of a total population thereby eliminating the search for matched control groups since each child is used as his own control over time. However, many studies reportedly have explored and found significant relationships between general articulatory problems such as type and degree of corrective therapy on reading skills (42), the improvement of spelling ability when accompanied with auditory training (61), the relationships of spelling ability and articulation inaccuracy (20) and the effect of reading instruction on deviant speech (23). There is at least general agreement that speech and language skills are definitely related.

Purposes

From all of the foregoing, the related research of others, the previous research of the present investigators and their clinical experience as well, a series of questions emerged. These questions are stated in terms of some basic relationships that might be found in a sufficiently large and unbiased population of children that would permit generalization to broad segments of the educational system and thereby become significant guidelines for school administrators, teachers, psychologists and speech therapists.

The relationships to be explored were:

1) between school achievement and articulatory inaccuracy;

2) between school achievement and having or not having speech therapy;

3) between speech therapy and no speech therapy and the reduction of articulatory inaccuracy;

4) between articulatory inaccuracy at the beginning of school, at the end of the second and at the end of the third grades;

5) between certain perceptual modality abilities and such factors as
   a) speech inaccuracy
   b) school achievement
   c) changes in the perceptual modalities over time.

The remainder of this report is devoted to discussion of the three year longitudinal study through which it was expected some answers to these questions might be forthcoming.

CHAPTER II

METHODS

Information relative to the population to be studied, the assessment instruments and the procedures for collection and analysis of data are presented in the following chapter.

Population

Subjects for the study were selected from the entering first grade classrooms of two approximately equal sized, geographically adjacent public schools in a middle-class Chicago suburb (Wheeling, Illinois). The entire battery of tests described later was administered to every child entering the schools' first grade for the first time. The total population studied this first year numbered 259. School I provided 143 children for the study while School 2 provided 116 children. A set of pre-established criteria were used to decide which of the entering students would be retained in the study. They were:

1) adequate auditory and visual acuity (corrected) as determinted by the school nurse;

2) adequate emotional stability as determined by the school authorities;

3) adequate verbal intellectual ability as determined by the Lorge-Thorndike Intelligence Test (see page 14 for a discussion of the selection of this test.rather than the Peabody Picture Vocabulary Test which was originally designated as the verbal intelligence indicator);

4) an articulatory pattern that was age-appropriate as determined by the Dual Modality Test of Articulation (see pages 5 and 6 of this manuscript);

5) first attendance in first grade.

A final criterion, residence in the school community throughout the three years of the study, was determined upon completion of the third year. At the time of the second year testing, six children were not available for this purpose for various reasons. These six children were included, however, in the first and third year populations, thus the N for year 2 (171) is different from the N's of years 1 and 3 (177).

On the basis of these criteria subjects were rejected from the study in the following numbers:

1) poor auditory acuity	2
2) severe emotional problem	1
3) low verbal intelligence (below 80 IQ)	4
4) articulatory pattern not age appropriate	10
5) first grade repeater	1
	N = 18
6) moved from community during course of study	N = 64
	N = 82
(children not available at second year testing only)	N = 6

The number of subjects meeting all criteria for years 1 and 3 were 177 (259 - 18 - 64 = 177). Of this number, School 1 provided 99 and School 2 provided 78.

For purposes of exploring the relationship between developmental articulatory inaccuracy and school achievement the population was divided into two groups. Guidelines for this division were based on an earlier study (31) that explored and confirmed the existence of articulatory error patterns which are developmentally age appropriate rather than pathological in nature. Group I consisted of those children who did not have consistent deviation in articulation as evidenced by the Dual Modality Test of Articulation (DMTA). The errors that the children in this group made were intermittent, never showing more than one error on any of the sounds tested. Group II included children who demonstrated consistent errors on the DMTA--usually making two or more errors on a sound.

The division of the groups was based on inspection of the error distribution of the population. The division fell between five and six errors. (Each sound is tested four times with the exception of the sound /th/. There are, then, 86 opportunities to make errors on the test.) Thus, Group I consisted of children who made five or less errors on the DMTA. They are considered to be the normal or control group; they numbered 111. Group II are children who made six or more errors on the DMTA. They are considered to be the experimental group; they numbered 66.

To explore the differential effect of speech therapy on (a) school achievement and (b) articulation, a further subdivision was made of the children in Group II. Group IIa was made up of children from School 1 who were assigned to speech therapy (N = 34). Group IIb was made up of children from School 2 who were withheld from speech therapy (N = 32) during the three years of the study. While selection based on geographical location provided an unequal number of children in the two groups, and, as will be seen later, differing articulatory error means, it permitted a selection of cases for the two groups without examiner bias in the determination.

Assessment

Essentially the same battery of tests was administered to the subjects on three separate occasions. School achievement tests were substituted for reading readiness tests in the second and third year administration of the battery. In addition, there were modifications made in the experimental Oral Motor Movement Test in order to increase its reliability.

The test battery consisted of the following tests (described in detail in Chapter III).

I. Verbal Intelligence Tests
  a) Lorge-Thorndike Group Intelligence Test
  b) Peabody Picture Vocabulary Test

II. Dual Modality Test of Articulation (Morency)

III. Perceptual Tests
  a) Auditory
    1) discrimination (Wepman)
    2) memory (new - experimental)
  b) Visual
    1) discrimination (Weiner, Wepman and Morency)
    2) memory (Weiner, Wepman and Morency)
  c) Oral Motor Movement (new - experimental)
  d) Visuo-Motor (Bender Visual Motor Gestalt Test)

IV. Reading
  a) Metropolitan Reading Readiness (Year 1 only)
  b) Metropolitan Achievement Test (Years 2 and 3)

The Oral Motor Movement Test was found to be unreliable in the form used in year 1. A different form was devised and found to be quite reliable and substituted during years 2 and 3. (See test description in Chapter III and Appendix A for intercorrelations obtained between tests on each of the three administrations.)

Assessment Procedures

For each of the three administrations of the test battery a team of examiners were trained for a period of two weeks by the principal investigator and the project director. The examination team consisted of graduate students in Psychology and Education at the University of Chicago. They are identified elsewhere in the report. Each examiner was responsible for certain of the tests. Subjects were then routinely examined in a different order depending solely on the chance of being assigned to one examiner or another to begin their evaluations. This provided a randomization of order offsetting any bias that might occur from an established pattern.

Data Collection

A number was assigned to each child as he entered the first testing session. The Metropolitan Readiness Test had been administered to the children by the classroom teacher at the end of kindergarten. The first administration of the individual tests, consisting of the tests of articulation, perception and the Peabody Picture Vocabulary Test were administered the first week of first grade. The Lorge-Thorndike Group Intelligence Test (Form A, Level 1) was administered in February of the first grade by the classroom teachers under the supervision of the school system's Director of Instruction.

The second administration of the individual tests was conducted during the last two months of the second grade. The Metropolitan Achievement Test (Primary Battery, Form B) were administered by the classroom teachers immediately following completion of the individual testing, again under the supervision of the Director of Instruction.

During the third grade, the Lorge-Thorndike Group Intelligence Test (Form A, Level 1) was again administered under the same circumstances that existed in first grade. The individual tests and the MAT (Form A) also followed the identical time schedule established for the second grade. A face sheet recording all of the test products was made for each child and given his number. (See Appendix B for facsimile face sheet and individual test protocol forms for the experimental tests.) After all of the data were recorded on the face sheets and punched by subject number on IBM cards, data analyses were performed on an IBM 7094 computer using programs developed for this study by R.A. Jenkins that are now in the University of Chicago Program Library.

Statistical Treatment of Data

Comparisons between groups were made by t test where appropriate. When the distributions appeared to be normal but of unequal variance, a Welch t approximation was used. When the distributions were markedly skew a chi-square test was used.

Comparisons of variables within groups were made using the differences and a t test.

All variables were correlated for the total sample and regression equations predicting individual variables from Lorge-Thorndike IQ were derived from the correlations and standard deviations. Some comparisons were made using the differences between a variable and the value predicted by regression on IQ. In a sense, these differences are over- and under-achievement scores. Significances of correlations were determined by reference to a table of the distribution of r.

CHAPTER III

THE TEST BATTERY

This chapter discusses each of the tests used in the study. The tests of intelligence, vocabulary, auditory discrimination, visuo-motor gestalt, reading readiness and school achievement are standard forms. The reliability and validity of each is quoted from the test manuals. The additional tests of perceptual function are being presently standardized by the Speech and Language Research Laboratory. Wherever reliability and validity data is available it is presented; for the most part, however, such data is not yet in a condition suitable for presentation.

The tests are presented in the following order:

Intelligence
   Lorge-Thorndike Intelligence Test *

Vocabulary
   Peabody Picture Vocabulary Test *

School Achievement
   Metropolitan Reading Readiness Test *
   Metropolitan Achievement Test *

Articulation
   Dual Modality Test of Articulation **

Perceptual
   Auditory Discrimination Test *
   Auditory Memory Test **
   Visual Perception Tests ** (Discrimination and Memory)
   Oral Motor Movement **
   Visuo-Motor (Bender) * (Koppitz Scoring)

* Standard form
** Experimental form

The Lorge-Thorndike Intelligence Test

The Lorge-Thorndike Intelligence Test (28) is a group test which yields IQ equivalents, grade percentiles and grade equivalents. Level 1 of the test is appropriate for kindergarten - Grade 1, Level 2 for Grades 2-3 in average socio-economic communities. Together, Levels 1 and 2 comprise the Primary Battery. Each level has two equivalent forms, A and B. The forms contain three subtests, each lasting 7-8 minutes. The entire form is never administered in one sitting. The Lorge-Thorndike Primary Battery forms are power tests and items are untimed. Individual items in the Primary Battery are pictorial. Questions requiring verbal understanding and reasoning are read by the teacher--the pupil responds by marking pictures. The pupil need not be able to read to take the test. The Primary Battery correlates with three other group tests of intelligence, the California Test of Mental Maturity, the Kuhlman-Anderson and the Otis Tests of Intelligence, at .56, .63, and .67, respectively.

The Peabody Picture Vocabulary Test

The Peabody Picture Vocabulary Test (14) is designed to provide an estimate of a subject's verbal intelligence through measuring his hearing vocabulary. The test is appropriate for subjects 2 years 6 months to 18 years. No oral or reading ability is required. The test yields IQ, percentile equivalents, and MA scores. It was administered individually in this study, though group testings are possible. The subject is required in some manner, usually by pointing, to indicate his choice from four pictures presented which picture goes with the word the examiner has presented orally. The only equipment needed is the published series of plates and scoring forms for each subject. There are two equivalent forms, A and B.

The manual for the PPVT reports the test has correlated highly with other well-established measures of intelligence. Cited as examples are the Revised Stanford-Binet Tests of Intelligence, the Revised Van Alsteyne Picture Vocabulary Test and the Revised Columbia Mental Maturity Studies. Reliability data for the PPVT has indicated that the two forms of the test are highly correlated for all age levels of normal, mentally retarded and cerebral palsied subjects. No evidence for test-retest or longterm reliability was cited by the author of the PPVT.

There are 150 items on the entire test. However, by the establishment of a basal and ceiling it is necessary to administer only a segment of the total test.

Originally, this test was planned to be the primary source of intelligence data of the population of this study. Subsequent work with the PPVT has led to questions regarding its validity and to some extent its reliability (25, 33, 34). The PPVT thus was included in this report in order to further assess its usefulness in light of reported inconsistent data.

The Metropolitan Achievement Tests

The Metropolitan Achievement Test (15) is designed to be a coordinated series of measures of achievement in the important skill and content areas of the elementary and junior high school curriculum. It has five levels or batteries, the first three of which were used in the present study, i.e., Primary I, Primary II and the Elementary Battery. The tests' content of the various batteries is designed to tap the most important knowledge or skill areas of the grade(s) for which a particular level is intended. Each level yields standard scores, percentile ranks and grade level equivalents. Repeated extensive standardization studies, using over 200 school system populations,have provided the normative data. Split-half reliability coefficients show a median r, range of .80-.94 for subtests of the first three batteries.

Each MAT battery is administered to groups in several sittings by the classroom teacher. Primary I Battery has three alternate forms and is appropriate for the latter half of grade 1. It contains four subtests: word knowledge, word discrimination, reading and arithmetic concepts and skills. For most items, the teacher presents the explanations and questions orally and the children mark their answers in individual test booklets. The subtests are timed. Primary II Battery also has three alternate forms. It is appropriate for grade 2. In addition to the four subtest categories in the previous battery, a spelling test is also included at this level. The same general administrative procedures are used throughout the levels with the student, of course, taking more responsibility for understanding and following instructions the older he is.

The Elementary Battery has four alternate forms and is appropriate for the third and fourth grades. In addition to the five subtests on the previous battery, language and arithmetic subtests are included.

The Dual Modality Test of Articulation (Morency)

The Dual Modality Test of Articulation was designed to demonstrate for the examiner a particular child's articulatory proficiency on initial consonant sounds in relation to his growth level in the developmental sequence of acquiring sounds (30). This is accomplished by listing the sounds that are being examined on a recording sheet in the order that 75 percent of the children in Templin's study (45) properly articulated the sounds tested in the initial position.

The test consists of two parts, one part of the test uses visual stimuli and the other uses auditory stimuli. In the visual section, the subject is shown pictures and asked to name them. Two pictures are given for each sound. In the auditory section of the test, the subject is instructed to repeat stimulus words after the examiner. There are two words for each sound. In the auditory part of the test, the subject is instructed to look away from the examiner. The words themselves are non-substantive and have little direct visual correlates. There are four opportunities to test each initial consonant.

The test yields error scores. In addition, because the sounds are listed in a developmentally acquired order, it is possible, by inspection of the profile of errors that are recorded, to interpret the nature of the articulation inaccuracy. That is, the determination of a developmental versus an organically based pathological articulation inaccuracy can be at least initially made by the location of errors on the recording form. A clustering of errors toward the end of the test, and particularly in the last 10 sounds on the test would tend to indicate a developmental articulatory inaccuracy.

Auditory Discrimination Test (Wepman)

The Wepman Auditory Discrimination Test (53) is designed to assess a child's ability to recognize the fine differences between phonemes used in English speech. Two equated forms of the test are available. The test is generally appropriate for children beginning at age 5. No visual, speech or reading ability is required to take the test. The test is administered individually, is untimed and takes only a few minutes. The child is asked to listen to selected words read aloud to him. He is then asked to make only one decision--are the two words exactly alike or are they different? He responds any way he chooses--just so the examiner understands his intention. Each form of the test consists of 30 pairs of monosyllabic words, differing in a single phoneme in each pair, and 10 word-pairs, which do not differ at all. The contrasting phonemes in each word-pair are always in the same position, i.e., initial, medial or final.

Reliability measured by test-retest administration (N = 109), as reported in the manual, was + .91. Reported in the literature are many studies that show auditory discrimination, as assessed by the Wepman Auditory Discrimination Test, to be related to the development of speech accuracy and reading ability (4, 11, 12, 13, 16, 19, 21, 22, 24, 31, 36, 37, 41, 47, 50, 53, 54, 57).

The Auditory Memory Test

The Auditory Memory Test was developed for and first administered to a large group in the present study. The present study, it is expected, will provide the initial normative data. The test in intended to be a measure of immediate recall of English phonemes (nonsense syllables). It can be administered in a few minutes. The units that are used consist of the /ē/ preceded randomly by one of the eight consonants that are acquired early in children's speech (31, 45). The test begins with two units and increases through eight units. There are two trials at each level. The second trial for each level need not be given if the first trial was successful. The test continues until the subject fails to recall both trials on the same level, or, of course, to the successful completion of the eight unit level.

The score is the number of units in the longest series correctly reproduced by the child.

Test of Visual Perception

The Tests of Visual Perceptual Ability consist of tasks utilizing visual memory and visual discrimination. The stimulus figures are the nine Wertheimer (59) geometric figures that were adapted by Bender for her Visual Motor Gestalt Test (3). The tests are multiple choice in form and therefore motoric facility is not required to take the test. In the memory task, the test item is exposed for 5 seconds and then removed. A sheet with four designs--the original one and three erroneous ones--was then exposed and the child was asked to indicate the correct design. In the matching task, both sheets are exposed simultaneously--the sheet with the original design and the sheet with the original design and three erroneous ones. The child is asked to point to the drawing on the four design sheet that is identical with the drawing on the other sheet. The memory task is necessarily always presented first.

The standardization data for this test is still being compiled and will be reported later.

The Oral Motor Movement Test

The Oral Motor Movement Test is a modification of a known clinical tool. The present study is one of its first large-scale uses. Standardization data are largely forthcoming and unpublished at the present time. This test was included in the study to facilitate an analysis of articulation inaccuracies. It is designed to be a measure of motor facility in the physical speech mechanisms. The test is simple, requires no apparatus other than a stopwatch and takes only a few minutes to administer. The subject is first asked to repeat the sounds "pa", "ta" and "ka" individually then in rapid sequence. He is then asked to put the sounds together in the nonsense word "pataka" and repeat this rapidly. The same procedure is used with two other verbal formulations "put take" and "bad dog" though in these instances no practice period is involved. The number of repetitions of each task per 5 second period is recorded and the average of these becomes the score.

Visual Motor Gestalt Test (Bender)

The Bender Visual Motor Gestalt Test (2) is a clinical test found to be useful in assessing and describing a wide range of psychological and organic pathologies. It also has been found to relate well to school achievement in the early school years and to intelligence in children (27). The test consists of nine designs which are presented one at a time and which the subject is asked to copy on a blank sheet of paper. The administration of the test is fundamentally individual though one examiner can observe small (3 or 4) groups taking the test after individual instructions and designs have been presented. The test takes only a few minutes to administer.

A fairly voluminous body of research relevant to the Bender Gestalt Test has emerged since the test's origin in 1938. A large part of this research has dealt with children's protocols and developmental aspects of the visual motor task. Koppitz (27) has devised an objective scoring system for the Bender test when used with young children. The Koppitz scoring system was employed in the present study. Koppitz also has determined age norms for normal school children. She has shown the test to be relevant to school achievement, emotional disturbance, brain injury and mental retardation.

Reliability in a test-retest situation yielded statistically significant chi-squares for nine out of twelve groups (6-8 years in age).

CHAPTER IV

RESULTS

The results of the data analysis and comparisons of articulatory error distributions are presented in this chapter. Most of the results except those dealing with progression of dependent variables through the three years of the study are reported in terms of the 177 children seen in the first and third years. Because six children were unavailable for testing in the second year, the total N for that year was 171.

Specific Results

Table 1 shows the distribution of the subjects of the study divided into groups according to articulation, in terms of CA and IQ.

Table 1

The comparison of the control and experimental groups at the time of initial testing on all of the subtests of the experimental battery is shown in Table 2.

Table 2

Tables 3a and 3b show the difference in mean achievement for each of the subscales of the Metropolitan Achievement Test made by the two groups, the standard deviation of the difference between the means and an appropriate test of the significance of the difference between the two means. (In this instance, since the distributions appeared normal and the variances similar, the Student t was used.)

Table 3a

Table 3b

Table 4a shows the relationship between Group I and II by comparisons of means of attainment in school achievement (MAT subscales) and the significance of the difference between the means at the second year level.

Table 4a

TABLE I.

DISTRIBUTION OF CHRONOLOGICAL AGE AND I.Q. IN TOTAL POPULATION

	N	MEAN C.A.	S.D.	RANGE	MEAN L-T IQ	S.D.	RANGE
SCHOOL A							
GROUP I (NORMAL)	63	76.127	4.022	70-91	116.516	12.176	88-141
GROUP II (EXPERIMENTAL, THERAPY)	34	75.059	4.185	69-83	112.853	11.415	92-136
	N	MEAN C.A.	S.D.	RANGE	MEAN L-T IQ	S.D.	RANGE
SCHOOL B							
GROUP I (NORMAL)	48	76.042	3.182	70-82	110.404	9.129	83-127
GROUP II (EXPERIMENTAL, NO THERAPY)	32	75.812	4.439	68-84	113.677	13.524	87-142

NO SIGNIFICANT DIFFERENCES BETWEEN OR AMONG GROUPS WAS FOUND FOR EITHER OF THE VARIABLES, CHRONOLOGICAL AGE, OR IQ.

TABLE 2.

MEAN ATTAINMENT OF GROUPS I & II ON INITIAL TESTING WITH EXPERIMENTAL BATTERY

EXPERIMENTAL VARIABLES	MEAN		S.D.		t	d.f.	S/NS
	I	II	I	II			
C.A.	76.09	75.42	3.67	4.29	1.10*	175	NS
PEABODY	109.98	106.36	14.15	15.28	1.60*	175	NS
AUDITORY DISCRIMINATION	4.62	6.27	4.12	6.13	-1.91**	97	NS
AUDITORY MEMORY	3.02	2.79	1.03	.73	1.73**	169	NS
VISUAL DISCRIMINATION	3.36	3.39	1.52	1.88	-.12**	115	NS
VISUAL MEMORY	4.87	4.70	1.57	1.67	.71*	175	NS
MOTOR MOVEMENT	4.97	4.82	1.61	1.58	.62*	175	NS
LORGE-THORNDIKE IQ	113.88	113.25	11.33	12.37	.35*	172	NS
METROPOL.READING READINESS TEST, TOTAL	70.73	63.95	23.06	27.35	1.75	173	NS
ARTICULATION TOTAL	1.80	12.05	1.62	6.14	-11.18***	-	.01
[illegible]	7.83	8.18	3.27	3.05	-.72*	172	NS

*STUDENT t USED.
** WELCH t USED DUE TO SIGNIFICANT DIFFERENCE IN VARIANCES.
*** WILCOXON STATISTIC USED DUE TO NON-NORMAL DISTRIBUTIONS.

TABLE 3 a.

COMPARISON IN SCHOOL ACHIEVEMENT BETWEEN GROUPS I & II WITH IQ REGRESSED OUT

YEAR 2 GROUP I, N=111 GROUP II, N=66

M.A.T. SUBSCALES	I		II		STUDENT		
	MEAN	S.D.	MEAN	S.D.	t	d.f.	p
WORD KNOWLEDGE	1.04	6.96	-1.34	7.76	2.07	169	.05
WORD DISCRIMINATION	.57	6.21	- .85	7.15	1.36	169	-
READING	.86	6.43	-1.06	7.22	1.81	169	-
SPELLING	1.00	6.63	-1.26	7.63	2.04	169	.05
ARITHMETIC, COMPUTATION	-.06	8.91	.18	9.29	-.17	169	-
ARITHMETIC, PROBLEM SOLVING	.78	6.83	-1.00	6.87	1.66	169	-
ARITHMETIC, TOTAL	.51	7.22	- .63	7.09	1.02	169	-

d.f. LESS THAN 175 (111 + 66 - 2) DUE TO MISSING OBSERVATIONS.

TABLE 3 b .

COMPARISON IN SCHOOL ACHIEVEMENT BETWEEN GROUPS I & II WITH IQ REGRESSED OUT

YEAR 3 GROUP I N= 111 GROUP II N= 66

M.A.T. SUBSCALES	I		II		STUDENT		
	MEAN	S.D.	MEAN	S.D.	t	d.f.	p
WORD KNOWLEDGE	1.04	7.06	-1.61	6.63	2.46	173	.02
WORD DISCRIMINATION	.70	6.34	- .95	6.90	1.61	173	-
READING	.48	5.38	- .51	5.92	1.13	173	-
SPELLING	.58	6.82	- .70	7.12	1.18	173	-
LANGUAGE USAGE	.36	5.67	- .52	6.27	.96	173	-
LANGUAGE PUNCTUATION	.74	5.94	- .97	5.59	1.88	173	-
LANGUAGE TOTAL	.69	5.59	- .93	5.61	1.84	173	-
ARITHMETIC,COMPUTATION	.23	7.41	- .08	7.88	.26	173	-
ARITHMETIC,PROBLEM SOLVING	.12	6.72	.03	7.54	.08	173	-

d.f. LESS THAN 175 (111 + 66 - 2) DUE TO MISSING OBSERVATIONS.

TABLE 4a.

COMPARISON IN SCHOOL ACHIEVEMENT BETWEEN GROUPS IIa & IIb WITH IQ REGRESSED OUT

YEAR 2 GROUP IIa N=34 GROUP IIb N=32

M.A.T. SUBSCALES	IIa MEAN	IIa S.D.	IIb MEAN	IIb S.D.	STUDENT t	d.f.	p
WORD KNOWLEDGE	-.59	6.34	-2.15	9.12	.79*	53	-
WORD DISCRIMINATION	-.46	7.13	-1.28	7.27	.46	63	-
READING	1.02	6.01	-3.34	7.82	2.53	63	.02
SPELLING	-.36	7.68	-2.24	7.57	.99	63	-
ARITHMETIC, COMPUTATION	.09	9.91	.28	8.72	-.08	63	-
ARITHMETIC, PROBLEM SOLVING	-.46	7.08	-1.60	6.70	.67	63	-
ARITHMETIC, TOTAL	-.23	7.97	-1.07	6.07	.47	63	-

* WELCH t USED DUE TO SIGNIFICANT DIFFERENCE IN VARIANCES.

d.f. LESS THAN 64 (34 + 32 - 2) DUE TO MISSING OBSERVATIONS.

Table 4b shows the same relationship at the third year level for the two groups.

Table 4b

Table 5 shows the changes that occur in articulatory inaccuracy by the error score means of Group II at each of the three year levels of the study. Here differences between the means again becomes the fundamental test of changes in articulation over time.

Table 5

This important relationship is further shown in Figure 2 where articulatory error profiles are shown at each age for the children in Group II.

Figure 2

Table 6 shows a comparison of the articulatory inaccuracy for Groups IIa and IIb for each year of the study. Because of the skewness of the distributions the groups were compared by a chi-square test.

Table 6

When error profiles are drawn showing the changes in articulation over time within the therapy/no therapy groups, the data shown in Figures 3a, 3b, and 3c become important sources of information. Here at each age level the actual sounds made in error, the percentage of children making errors on each sound and the number of children making errors are shown at each age level, Figure 3a, year 1; Figure 3b, year 2; Figure 3c, year 3.

Figure 3a

Figure 3b

Figure 3c

TABLE 4b.

COMPARISON IN SCHOOL ACHIEVEMENT BETWEEN GROUPS 11a & 11b WITH IQ REGRESSED OUT

YEAR 3 GROUP 11a N=34 GROUP 11b N=32

M.A.T. SUBSCALES	11a		11b		STUDENT		
	MEAN	S.D.	MEAN	S.D.	t	d.f.	p
WORD KNOWLEDGE	-.99	5.81	-2.29	7.46	.79	63	-
WORD DISCRIMINATION	.25	6.67	-2.26	7.02	1.48	63	-
READING	.78	5.17	-1.93	6.44	1.88	63	-
SPELLING	.04	6.60	-1.51	7.68	.87	63	-
LANGUAGE USAGE	-.78	4.98	- .24	7.51	-.34*	51	-
LANGUAGE PUNCTUATION	-.31	5.92	-1.70	5.21	1.00	63	-
LANGUAGE TOTAL	-.57	5.26	-1.32	6.04	.54	63	-
ARITHMETIC,COMPUTATION	1.51	8.49	-1.82	6.86	1.73	63	-
ARITHMETIC,PROBLEM SOLVING	.99	6.68	-1.03	8.37	1.08	63	-

* WELCH t USED DUE TO SIGNIFICANT DIFFERENCE IN VARIANCES.
d.f. LESS THAN 64 (34 + 32 - 2) DUE TO MISSING OBSERVATIONS.

TABLE 5.

ARTICULATION TOTAL ERRORS; SIGNIFICANCE OF DIFFERENCES BETWEEN YEARS

GROUP II

	MEAN	ERROR	N	t	d.f.	p.
YEAR 1 - YEAR 2	9.182	.725	66	12.665	65	.01
YEAR 2 - YEAR 3	1.424	.402	66	3.542	65	.01
YEAR 1 - YEAR 3	10.606	.694	66	15.282	65	.01

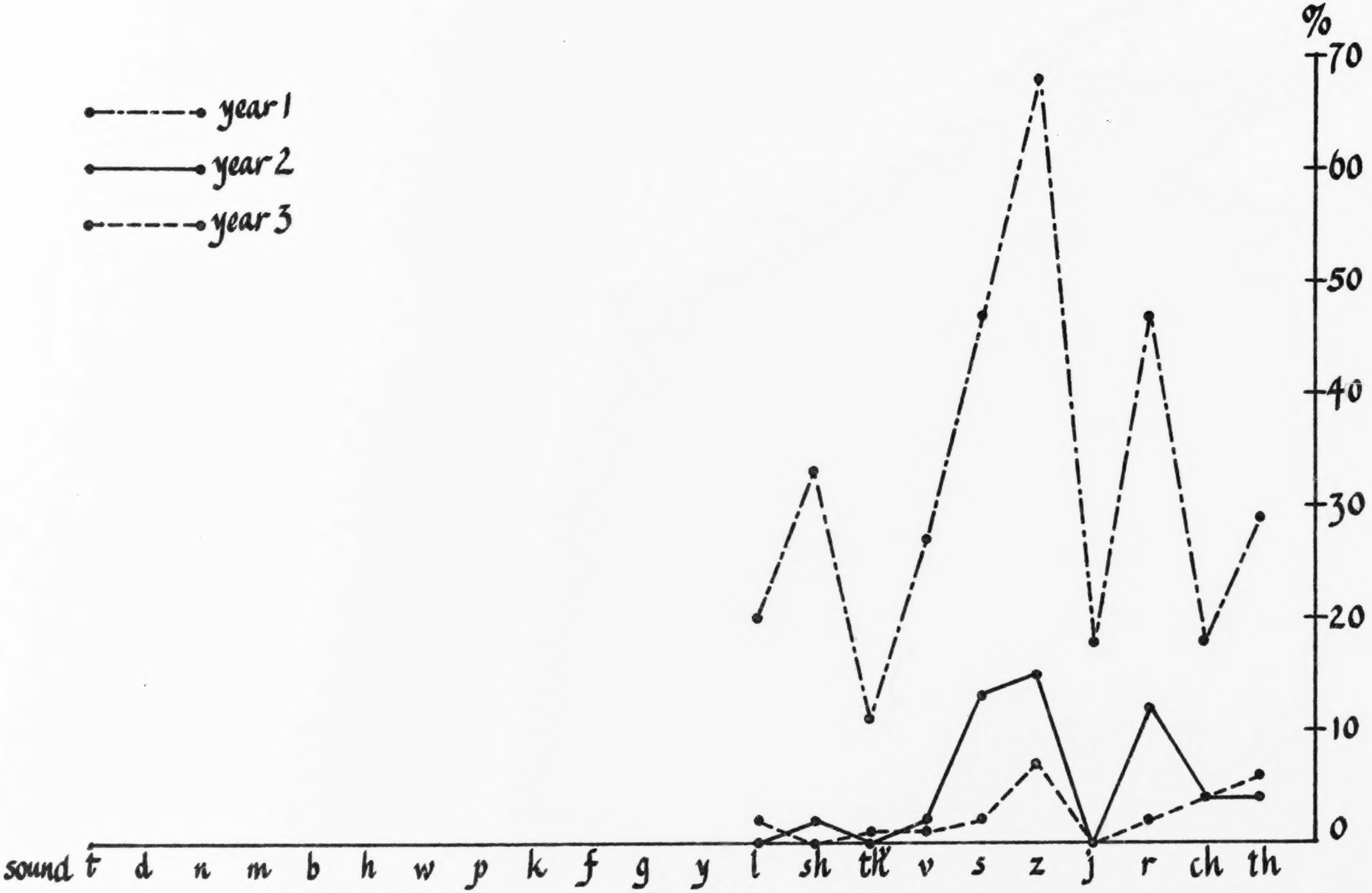


Figure 2

Percent of children in Group II (N=66) who made 2 or more errors on the Dual Modality Test of Articulation shown for each of the three years of the study.

TABLE 6.

COMPARISON OF ARTICULATORY INACCURACY BETWEEN GROUPS IIa & IIb WITH LORGE-THORNDIKE IQ REGRESSED OUT. GROUP IIa N=34 GROUP IIb N=32

	YEAR I ARTIC. TOTAL		YEAR 2 ARTIC. TOTAL		YEAR 3 ARTIC. TOTAL	
	IIa	IIb	IIa	IIb	IIa	IIb
MEAN	8.45	4.24	1.06	1.75	.60	.82
S.D.	6.72	4.63	3.64	3.33	2.87	2.74
χ^2	14.10		7.26		2.90	
d.f.	6		4		3	
p.	.05		-		-	

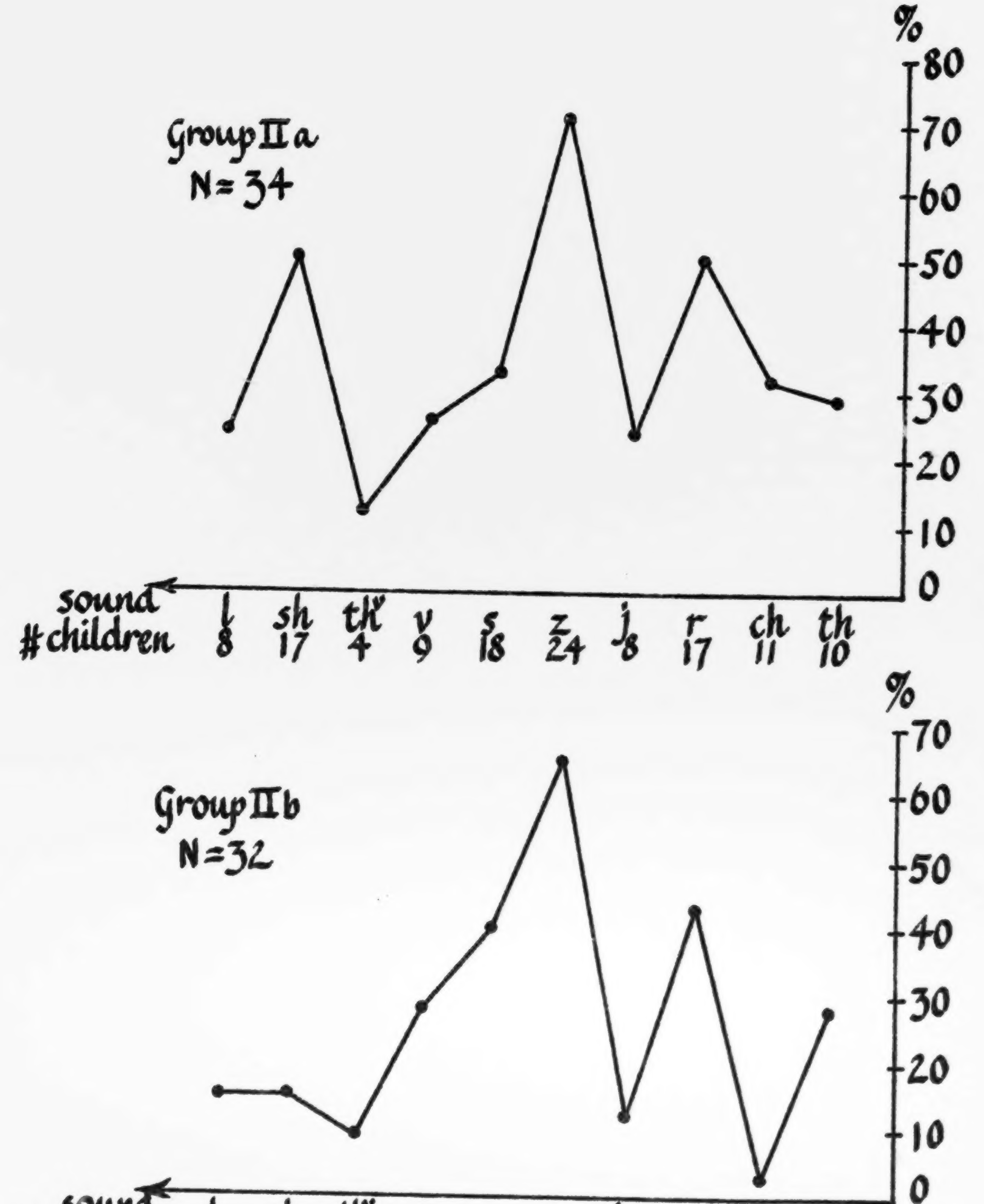


Figure 3a

Percent of children in Group IIa (therapy) and Group IIb who made two or more errors on the Dual Modality Test of Articulation in grade 1.

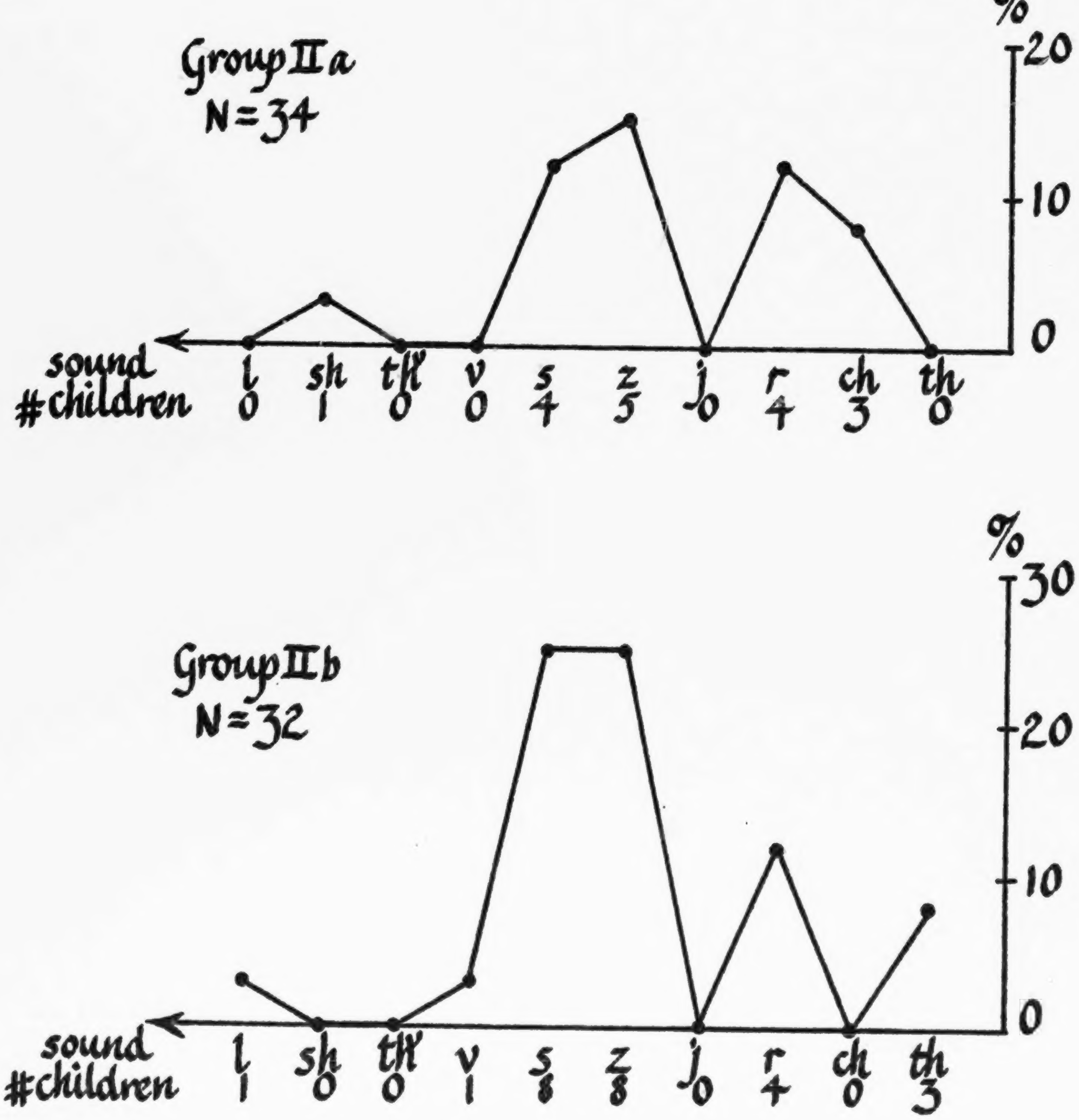


Figure 3b

Percent of children in Group IIa (therapy) and Group IIb who made 2 or more errors on the Dual Modality Test of Articulation in grade 2.

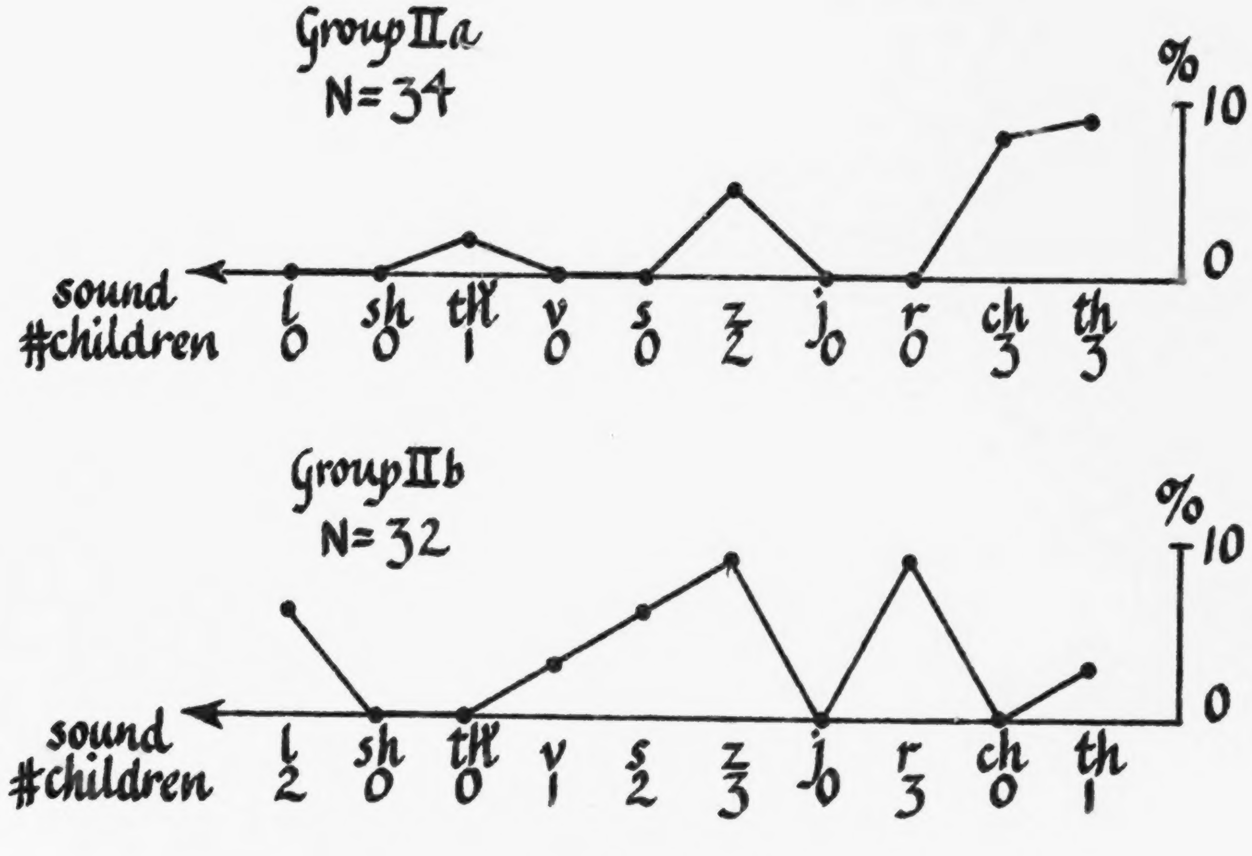


Figure 3c

Percent of children in Group II a (therapy) and Group II b who made 2 or more errors on the Dual Modality Test of Articulation in grade 3.

Figure 4 shows profiles of the incidental and inconsistent errors made by the children in Group I.

Figure 4

Table 7 shows a comparative listing of the sounds tested in the initial position in order of acquisition of accuracy by 75 percent of the population according to Templin's study (45), and in the order of difficulty at the first year level of testing in the present study.

Table 7

Table 8 shows perceptual modality achievement--mean difference scores at first and third grade levels.

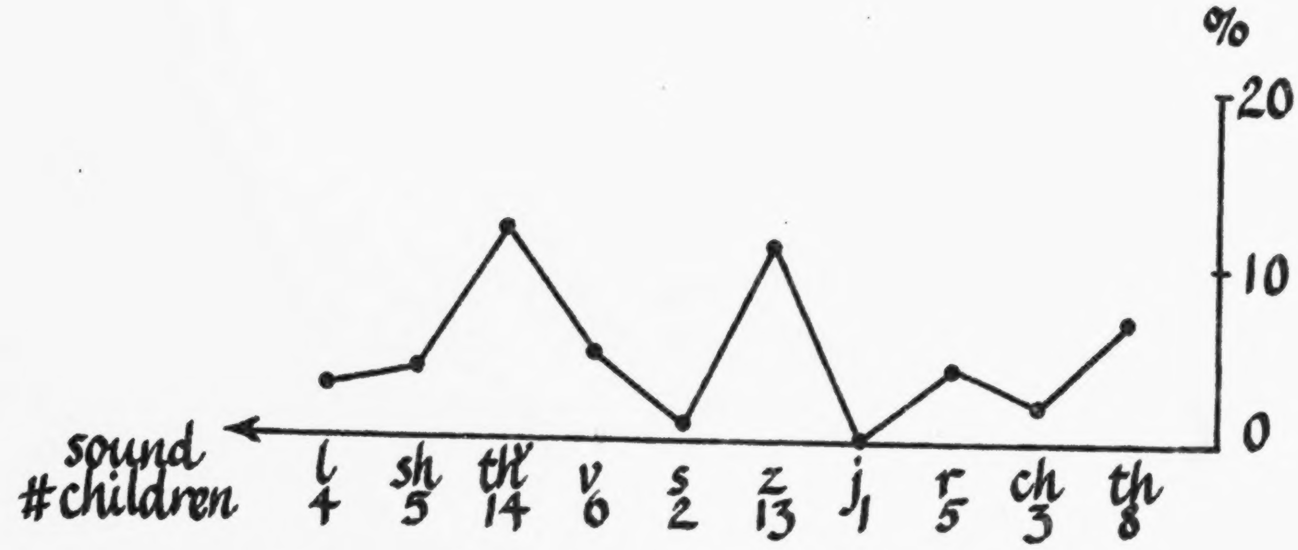
Table 8

Intercorrelations of the mean difference scores of the perceptual modality tests are shown in Table 9.

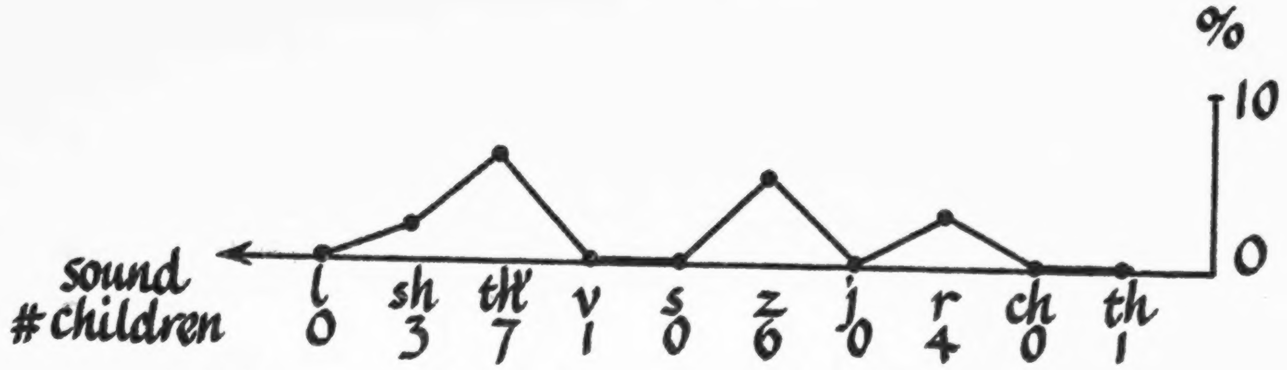
Table 9

Table 10 shows the correlations of the perceptual factors of vision and audition measured in the first grade with the subtests of the Metropolitan Achievement Test at the third grade.

Table 10



Percent of children in Group I (N=111) who made one or more errors on the Dual Modality Test of Articulation shown for year 1.



Percent of children in Group I (N=111) who made two or more errors on the Dual Modality Test of Articulation shown for year 1.

Figure 4

TABLE 7.

ORDER OF ACQUISITION OF SOUNDS

TEMPLIN	PRESENT STUDY
L	TH (VOICED)
SH	J
TH (VOICED)	CH
V	L
S	V
Z	TH (UNVOICED)
J	SH
R	R
CH	S
TH (UNVOICED)	Z

TABLE 8.

PERCEPTUAL MODALITY ACHIEVEMENT

MEAN DIFFERENCES BETWEEN SCORES AT FIRST AND THIRD GRADE LEVELS

TEST	N	MEAN SCORE DIFFERENCE (IMPROVEMENT)	STANDARD ERROR	t
AUDITORY DISCRIMINATION	172	3.436	0.412	8.34 *
AUDITORY MEMORY	177	- .305	0.076	- 4.01 *
VISUAL DISCRIMINATION	177	2.424	0.130	18.65 *
VISUAL MEMORY	177	2.797	0.150	18.65 *

* SIGNIFICANT AT .01 LEVEL

TABLE 9.

CORRELATIONS OF DIFFERENCE SCORES OF AUDITORY & VISUAL PERCEPTUAL ACHIEVEMENT

	AUDITORY DISCRIMINATION	AUDITORY MEMORY	VISUAL DISCRIMINATION	VISUAL MEMORY
AUDITORY DISCRIMINATION	1.000			
AUDITORY MEMORY	- .026	1.000		
VISUAL DISCRIMINATION	.108	-.163	1.000	
VISUAL MEMORY	.010	.149	.197	1.000

TABLE 10.

PERCEPTUAL FACTORS CORRELATED WITH SCHOOL ACHIEVEMENT N=177

METROPOLITAN THIRD GRADE ACHIEVEMENT	FIRST GRADE SCORES VISUAL DISCRIMINATION	VISUAL MEMORY	AUDITORY DISCRIMINATION	AUDITORY MEMORY	BENDER
WORD KNOWLEDGE	.246**	.240**	.348**	.237**	.418**
WORD DISCRIMINATION	.238**	.267**	.274**	.313**	.393**
READING	.244**	.237**	.235**	.274**	.406**
SPELLING	.244**	.270**	.283**	.304**	.372**
LANGUAGE USAGE	.205**	.132	.239**	.271**	.329**
PUNCTUATION	.274**	.199**	.305**	.289**	.446**
LANGUAGE TOTAL	.269**	.190*	.306**	.312**	.447**
ARITHMETIC, COMPUTATION	.231**	.214**	.286**	.213**	.467**
ARITHMETIC, PROBLEM SOLVING	.264**	.256**	.291**	.246**	.523**

* SIGNIFICANT AT .05 LEVEL
** SIGNIFICANT AT .01 LEVEL

CHAPTER V

DISCUSSION

This chapter is concerned with the analysis and interpretation of the results presented in the preceding chapters. It relates these findings to the theoretical position and objectives of the study.

Table 1, page 20, indicates how closely related the normal and experimental groups were in the common factors of chronological age and IQ. No significant differences in these factors were found even in the range or standard deviations. Table 1 also indicates no significant differences in CA or IQ between School A and School B which arbitrarily defined the therapy/no therapy division (Groups IIa and IIb).

Table 2, page 21, shows the comparability of the two major groupings on all of the variables tested in year one.

Since the control and experimental groups were divided on the basis of their articulatory error score it is to be expected that there would be, as there is, a difference in the means; Group I's mean is 1.80 errors per child, while the mean of Group II is 12.82 errors per child. It should be pointed out that although the difference between the groups in auditory discrimination ability is not quite significant, the difference in means is in the expected direction. Furthermore, when the range of articulation is not dichotomized, the correlation between articulation and auditory discrimination is significant (we would expect the difference between the groups to be less significant than the correlation because of the loss of information incurred in dichotomizing).

To be certain that any differential in intelligence within the distribution was not unduly biasing the results, the Lorge-Thorndike IQ (year 3) was regressed out of each subject's score. The independent variable then was articulatory accuracy in the first year. The dependent variable was school achievement as measured by differences between the two group means on each of the subscales of the Metropolitan Achievement Test in the second and third year. As Table 3a indicates, at the end of the second year no significant differences were found on five of the seven subscales. On two, Word Knowledge and Spelling, Group II did significantly less well (at the .05 level).

At the third grade (Table 3b), where nine subscale scores are available, only one, Word Knowledge, continues to show significant differences. In all other aspects of achievement--Word Discrimination, Reading, Spelling, Language Usage, Punctuation, Total Language Usage, and in both aspects of Arithmetic, Computation and Problem Solving--no significant differences between the groups were found.

The conclusion seems relatively clear. Beginning school with age-appropriate, developmental articulatory inaccuracy has little if any effect upon school achievement, i.e., children with articulatory inaccuracy do virtually as well as children with little or no articulatory error.

The relationship of articulation inaccuracy to achievement was explored in quite a different way. The Group II children were divided into two groups (IIa and IIb) with one group receiving speech therapy (IIa) and the other withheld from therapy (IIb). Examiner bias in selection was reduced by assigning all of the Group II children in School 1 to speech therapy--this became Group IIa--while all of the Group II children in School 2 were withheld from speech therapy. This formed Group IIb. The effect of therapy upon the articulation inaccuracy of the children involved is discussed later. The question at this point in the discussion is whether the division into therapy/no therapy groups could be discerned in measures of school achievement. Table 4a shows the difference in means on each of the seven subtests of the Metropolitan Achievement Test at the end of the second year. As the table shows, in only one of the seven, "Reading", was there a significant difference between the groups. In Word Knowledge, Word Discrimination, Spelling, and the three arithmetic subtests, Computation, Problem Solving and Total Arithmetic, no significant differences were found. Table 4b shows that even this single variable (Reading) that showed a significant difference between groups in year 2 failed to show this difference by the end of the third year. It will be recalled that in this study the effect of IQ had been regressed out. It would appear then that whether a child with developmental speech inaccuracy has therapy or not, no lasting effect upon school achievement presents itself.

The effect of speech therapy upon the articulatory inaccuracy of the children who began school with sufficient speech difficulty to be considered for speech therapy is shown in Tables 5 and 6. It is evident from Table 5 that these children showed a marked reduction in articulatory inaccuracy. Each year showed a significant change occurring.

Table 6 shows that the two groups, IIa (with therapy) and IIb (without therapy) each reduced their articulatory problem. While Group IIa showed a higher mean error in year 1, by the end of year 2 and continuing through year 3 the groups had literally no difference in their mean articulatory errors.

The conclusion here seems clear that in reference to children with developmental articulatory inaccuracy, speech therapy fails to achieve better speech than does simple change over time.

The profiles of articulatory errors are equally revealing and reflect rather accurately the statistical formulations. Figure 2 shows the sounds made in error and the number of children making two or more errors on each sound at each of the grade levels on the Dual Modality Test of Articulation. Figures 3a, b, and c show the percent of children making two or more errors on each sound tested for each year of the study. Here the profiles show the differences between Groups IIa and IIb. Since errors occurred on the last ten sounds of the Templin acquisition order listing, the profiles show only misarticulations of these sounds. Figure 4 shows profiles of the incidental and inconsistent errors made by the children in Group I. The pattern is seen to be the same, though the number of children and the number of errors made is far less. This was also the finding of a previous study by the present investigators which led to the concept of the child with a developmental rather than a pathological articulatory problem (31).

The order of errors within the last ten sound grouping is of some interest. It is to be noted on Figure 2 that the order of difficulty at the first year level, reading from least difficult to most difficult, would be unlike the stipulated order of the Templin study. For comparison of this order, Table 7 shows a comparative listing of the sounds as they are said to be acquired. If one uses 100 percent mastery over the articulation of a given sound as the sole criteria of acquisition, the order would follow the second column rather than the Templin ordering. It should be recalled, however, that Templin's list is made up of an order at which 75 percent of children had acquired the correct pronunciation while the ordering of the present study indicates the total errors for a given sound.

The naturalness of the order of the present study, however, is borne out by the almost identical profiles of errors of children at the second and third year of school and this ordering is identical with previous studies using the same test material (31). Of major importance is not the absolute ordering of errors, but the consistency of errors made in the first, second and third grades, the tendency for the errors to markedly decrease in number between the beginning of school and the end of the second year. Stated agewise, there is a marked resolution of errors during the sixth and seventh year of life with only minimal changes between the seventh and eighth years. The pattern of errors seems to remain relatively intact, only the number of children making the errors seems to decrease.

The separate groups' profiles (Figures 3a, b, and c) indicate the ordering of difficulty within the therapy/no therapy groups. Here the same patterns of errors and of resolution of errors over time seems quite evident. Therapy seems to have played only a minimal role in the recovery rate or in the order of recovery. This does not rule out the possibility that children with severe or very consistent errors on the sounds listed as those that relate to developmental articulatory inaccuracy might be fit subjects for therapy even though the groups show the amazing equality that they do in their third grade articulatory profiles. Concentrating on these few children and these few sounds in speech therapy should tend to reduce even further the number of children still making errors at the end of the third grade. This would free the speech therapist from the busy-work dealing with specific errors which children tend to overcome with maturation and development.

The questions of identification of children with developmental articulatory inaccuracy, and the noted resolution of this problem with the passage of time, is relevant to the vast majority of children who demonstrate consistent articulatory inaccuracies in the first grade. In the present study, as was seen, 10 children of a total of 259 originally examined had articulatory problems for other than developmental reasons. These children are always in need of special attention and the speech therapists role here cannot be overstated.

It appears valid to conclude from the data presented that the initial task of a school system with regard to its first grade children would be to screen the population for articulatory inaccuracy. Subsequent referral for speech therapy could be made for those whose etiology indicated a pathological origin (cleft palate, emotionally-based infantilisms, hearing loss, stuttering, etc). Also, if the situation permitted, therapy would benefit those children who demonstrate consistently inaccurate production of all or most of the last ten developmentally acquired sounds. Referring to this majority of developmentally inaccurate speakers as suffering from some sort of pathology or deficit cannot be beneficial to the individuals concerned. Separating developmental from true pathological speech disorders would eliminate this problem. The developmental inaccuracies could be handled by including in the instruction for an entire classroom techniques that tend to exercise both encoding and decoding ability on both perceptual and conceptual levels of learning. Such a procedure would reduce the work load of the speech therapist and concentrate his or her efforts in the area where it is most sorely needed.

It would seem further indicated that classroom teachers, administrators, other personal service personnel and especially parents should become aware of developmental speech problems as differentiated from the pathologically based disorders of speech. Not only should this information on the speech itself be made available, but also the information brought forth in the present study, that no known effect of the articulation inaccuracy can be demonstrated on early learning of school subjects.

The basic conclusion of the study is the relative independence of developmentally based articulation inadequacy from any other measure of developing capacity. As was indicated, chronological age and IQ as well as school achievement and articulation resolution seem unrelated to beginning school with age-appropriate articulatory inaccuracy. It should be noted that such children may have slower developing auditory perceptual abilities, and for those that do show this deficiency it is suggested that auditory training in discrimination and memory and possibly sequencing behavior might be beneficial. The tendency for children with poor articulation to show some lessened ability at word knowledge in the second grade and some initial difference in spelling at this grade level would point to these areas as needing some emphasis during the first and second grade. By the third grade, however, these differences are seen to disappear for the most part.

Table 8 shows the mean differences in auditory perceptual ability between scores at the first and third grade levels. The t test shows that this difference is significant. Table 8 shows the mean differences in visual perceptual ability between scores at the first and third grade levels. These differences are also significant, thus confirming the notion of a developmental progression.

It should be noted, too, as shown in Table 9, that correlations of improvement in the auditory modality with improvement in the visual modality are low, which is taken to mean that children who improve in one modality may or may not improve in the other. In other words, the study has shown that perceptual abilities develop significantly in the first three years of school in a normal population and that these abilities progress individually along lines of modality preference at differing rates in the same individual.

Table 10, page 38, shows the low but consistent relationship of the perceptual factors to achievement. Much of the foregoing has been in direct keeping with the theoretical formulation of the modality-based perceptual function in early learning in children. None of the four basic perceptual factors, auditory discrimination and memory or visual discrimination and memory are significantly interrelated. Again, this would be in keeping with the concept of differential modality development at the perceptual level. The rationale for this is discussed in the Introduction and in Appendix C as well as in the literature (54, 56, 58).

CHAPTER VI

CONCLUSIONS AND IMPLICATIONS

The study was designed to explore the relationships to be found between speech inaccuracy and school achievement especially in children who began their formal schooling with age-appropriate misarticulations (31). The importance of this factor in the educational careers of the children was seen as being, minimally, two-fold: first, the effect that such a relationship might have, if it existed, upon the emphasis of their early education; second, the effect upon teachers and parents if no such relationship was found. The concern here is so often expressed as being whether or not children delayed in speech accuracy might mirror other delays in their development. This belief regarding such children engenders treating them in many respects as handicapped or 'defective'.

The relatively unequivocal finding that such children showed no differences in their school achievement from their peers points to a resolution of the questions raised. From the evidence it can be rather flatly stated that beginning school with consistent misarticulation in speech has no discernible effect on a child's ability to learn, at least in the early stages of school achievement. This finding indicates the relative independence of speech articulation from the learning of school subjects.

The implications for educators and parents alike that follow from this seem self-evident. Such children are not handicapped or defective--they are merely developing speech accuracy at their own rate within the expected order and at the time in their lives when their perceptual abilities (upon which the inaccuracies are based) are also developing.

The study also explored what happened to the speech of these children during the first three years of school. The data here is equally forthright and equally significant. During the first school year the majority of misarticulations disappear. During the second and third year there is a further reduction to the point where only in a few children can any abnormality of articulation be discerned. For these children these are the formative years. Within the design it was possible to test the effects of speech therapy on such a population. The data here is equally clear--similar improvement occurs in both groups, those with and without therapy. Further, the fact of being exposed to therapy did little for the children in the sense of overall school achievement. In the few instances where the therapy group did somewhat better it was felt that simple application and attention to the language arts would probably accomplish the same results.

The testing of the therapy/no therapy paradigm as well as the longitudinal effect of overall resolution of the articulation problem over time leads to the further implication that, except in very severe problems, the speech therapists might be better occupied in seeing and working with a school system's pathologically-caused speech problems--stuttering, cleft palate speech or the speech efforts of the retarded.

Certainly, the parents of the children identified in the study as having developmental lags in speech accuracy should be made cognizant of the nature of the problem. This might result in the removal or reduction of parental pressure which is felt to be so important to the psychological well-being of children within this age group.

Teachers becoming aware of the lack of effect upon achievement as well as the natural resolution of the speech problem should experience less concern about the accuracy of articulation in either speech or oral reading. This should also result in decreasing the pressure so commonly placed on such children. Expectation so often establishes goals outside of the competency of the children in the early phases of their development that a reduction of expectancy goals should operate to their benefit in almost every way.

The tangential yet equally important finding that certain perceptual modality factors play a significant role in school achievement was a not unexpected finding. The relationships here while significant are low. They point to the fact that the tests used are probably poor predictors of later difficulties in learning for the majority of children. However, they are of sufficient magnitude that when deficiencies do occur in a given child the perceptual weakness and the modality involved should be taken into consideration in planning for any remedial work that is planned for a given child if indeed he falls behind in the learning process. For example, as the discussion of the perceptual-modality theory indicated, a given child with slower development of his visual perceptual ability than expected of his age or intellectual ability group should both have a stronger auditory emphasis on his early learning and a separate attempt to improve his more poorly developed visual skill. The opposite of this, of course, would be true of the child with inadequate development of his auditory perceptual ability. The implications for therapy for such children lie in the direction that such early identification of their learning potential produces.

The research provides some much needed normative data on the development of the various pathways of learning. It was limited, however, by its age range in providing the next step in our necessary knowledge of the effect of such early lags in perceptual development on the later learning which is more abstractive in nature than the rather methodological concrete stages of early school learning. Such further exploration is contemplated and in fact already under way. This research which is a natural follow-up to what has been reported here should and will explore a number of important areas about which no present information is available. Following the children of the present study through the next three years will provide data on the child with a continuing articulation problem which is no longer age-appropriate. The effect that such a continuing problem has on later school achievement; the effect that the perceptual lags which seem to have been overcome in the first three years have on the ease with which children make the transformation to higher levels of learning, or, stated otherwise, will slower development of perceptual factors cause the transition to be a more complex and difficult one.

The continuation research should answer many questions concerning the child who does not develop adequate perceptual abilities at what seems to be the appropriate age. It has been widely postulated that developmental inequalities of perceptual factors are all erased by the end of the ninth year of life. No evidence, however, has been produced of the truth of this hypothesis.

CHAPTER VII

SUMMARY

The research was designed to explore the relationship between articulatory inaccuracy and school achievement in children in the early elementary grades. A second purpose was to explore the effects of speech therapy upon school achievement as well as upon articulatory inaccuracy in this age school child. A secondary goal was to explore the role of perceptual ability along different modalities in both articulation and school achievement.

To accomplish these ends 177 children entering the first grade of two public schools nearby Chicago were administered a test battery including standard tests of intelligence (Lorge-Thorndike), vocabulary (Peabody Picture Vocabulary Test), articulation (Morency Dual Modality Articulation Test), reading readiness (Metropolitan Reading Readiness Test), auditory discrimination (Wepman Auditory Discrimination Test), visuo-motor ability (Bender Visual Motor Gestalt Test), and experimental tests newly developed for this and other research assessing visual discrimination and matching and oral motor movement. At the end of the second and third year of school the same battery was administered with the Metropolitan Achievement Tests being substituted for the reading readiness tests and used as an indication of school achievement.

The population was divided into two groups, Group I (N = 111) being those children who on initial testing showed less than five errors of articulation on the 86-item articulation test. The errors they made were found to be inconsistent, i.e., four opportunities for producing each sound of English are provided by the test, these children almost never made more than a single error on any sound. Further, they were judged by their teachers, the school speech therapists and the research team independently as not being children who were in need of special therapy for speech. Group II (N = 66) were those children who made six or more errors on the articulation test. The errors they made tended to be consistent, i.e., they made two or more errors on the same sound. Within general limits the groups were equated for intelligence (all Lorge-Thorndike IQ's were above 90), for socio-economic and educational opportunity backgrounds (they all came from adjacent sections of the same Chicago suburb). They were all free of demonstrable emotional problems, hearing loss or pathologies that might have contributed to their articulation inaccuracy. The errors made by Group II were noted as being within the last ten sounds said to be acquired by all children (45) and met the criteria established by the present researchers for children with developmental articulatory inaccuracy rather than pathological speech defects.

For purposes of testing the effects of speech therapy on such children Group II was subdivided into two groups, Groups IIa and IIb. The former group (N = 34) was assigned to group therapy. The latter group (N = 32) was withheld from therapy during the three years of the study. The division into therapy or no therapy groups was done geographically. All the children in Group II from one of the two schools were assigned to therapy. All of the children from Group II from the other school were assigned to the no therapy group. This avoided the problem of selection and any bias that might enter by the selection process.

The results of the study showed that: 1) No lasting difference in school achievement occurs as the result of a child beginning school with developmental speech inaccuracy; 2) No lasting effect on school achievement occurs as the result of a child with articulatory inaccuracy having speech therapy or being withheld from such therapy during the first three years of school; 3) By the time these children reached the third grade no difference appears in their articulation pattern whether or not they have speech therapy; and 4) There is a low but statistically significant relationship between the perceptual abilities and both articulation and school achievement.

From these results it is held that the common tendency to consider children who enter school with articulatory inaccuracy of the type described as suffering from some sort of general deficiency or defect in speech is unwarranted. Developmental speech inaccuracy that is age-appropriate in the sense of the expected order of acquisition of speech sounds should be considered as just that--a developmental phenomenon, not a defect or a lag in development. Further, the data warrants the conclusion that for the majority of these children speech therapy is unnecessary since with the normal passage of time and the development of the perceptual factors the inaccuracies are resolved as well without therapy as with it. Finally, the perceptual modality concept of early learning seems to be confirmed which leads to the conclusion that children's proclivity in learning, whether by eye or by ear, should determine the approach of choice in teaching them.

It remains to be discovered what the effect of articulatory inaccuracy has upon later learning in the higher grades where less specific methodology and more vicarious forms of learning are called for by the educational system. It also remains to be discovered whether the fact that a child begins school with a perceptual lag along a particular modality has an effect upon this higher level of learning. Such a study of the same children who served as the population of the present research is currently underway.

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APPENDIX A

TOTAL GROUP MEANS AND CORRELATION TABLES

TABLE 11.

SCHOOL ACHIEVEMENT AS RELATED TO DEVELOPMENTAL SPEECH INACCURACY

TOTAL GROUP CORRELATIONS -- VARIABLES FOR ALL YEARS

VARIABLE	NAME	YEAR	MEAN	ERROR	N	DEVIATION	MIN	MAX
1	CA	1	75.842	0.294	177	3.914	68.000	91.000
2	PBDY IQ	1	108.633	1.101	177	14.641	75.000	145.000
3	AUD DISC	1	5.233	0.382	172	5.010	0.	27.000
4	AUD MEM	1	2.932	0.070	177	0.933	2.000	8.000
5	VIS MEM	1	4.808	0.121	177	1.605	1.000	8.000
6	VIS DISC	1	3.373	0.125	177	1.657	0.	9.000
7	MOT MOV	1	4.915	0.120	177	1.595	0.	9.000
8	L-T IQ	1	113.644	0.887	174	11.702	83.000	142.000
9	MET TOT	1	68.211	1.881	175	24.881	3.000	99.000
10	ARTIC TOT	1	5.621	0.477	177	6.344	0.	31.000
11	BENDER	1	7.960	0.242	174	3.188	2.000	17.000
12	CA	2	95.197	0.300	173	3.939	89.000	111.000
13	PBDY IQ	2	108.746	0.959	173	12.610	73.000	145.000
14	AUD DISC	2	2.474	0.247	173	3.250	0.	25.000
15	AUD MEM	2	3.306	0.062	173	0.817	2.000	6.000
16	VIS MEM9	2	3.341	0.141	173	1.860	0.	8.000
17	VIS DIS9	2	1.555	0.115	173	1.519	0.	6.000
18	MOT MOV MEAN	2	6.464	0.091	173	1.197	2.667	10.333
19	MET WD KNOW	2	52.295	0.753	173	9.910	26.000	68.000
20	MET WD DISC	2	53.133	0.627	173	8.248	33.000	66.000
21	MET READ	2	51.746	0.722	173	9.501	27.000	68.000
22	MET SPELL	2	54.873	0.698	173	9.187	32.000	67.000
23	MET AR SOLV	2	49.913	0.681	173	8.959	28.000	71.000
24	MET AR COMP	2	50.052	0.785	173	10.324	29.000	71.000
25	MET AR TOT	2	49.931	0.718	173	9.440	30.000	72.000
26	ARTIC TOT	2	1.462	0.207	173	2.725	0.	14.000
27	BENDER	2	3.457	0.177	173	2.324	0.	12.000

TABLE 11. (continued)

SCHOOL ACHIEVEMENT AS RELATED TO DEVELOPMENTAL SPEECH INACCURACY

TOTAL GROUP CORRELATIONS -- VARIABLES FOR ALL YEARS

VARIABLE	NAME	YEAR	MEAN	ERROR	N	DEVIATION	MIN	MAX
28	CA	3	106.780	0.296	177	3.943	99.000	122.000
29	PBDY IQ	3	108.266	0.940	177	12.512	67.000	145.000
30	AUD DISC	3	1.774	0.164	177	2.189	0.	18.000
31	AUD MEM	3	3.237	0.059	177	0.791	2.000	7.000
32	VIS MEM9	3	2.011	0.109	177	1.454	0.	7.000
33	VIS DIS9	3	0.949	0.079	177	1.057	0.	6.000
34	MOT MOV MEAN	3	7.169	0.097	177	1.286	4.000	10.667
35	MET WD KNOW	3	51.435	0.742	177	9.867	23.000	75.000
36	MET WD DISC	3	51.712	0.708	177	9.424	30.000	72.000
37	MET READ	3	50.492	0.672	177	8.944	26.000	69.000
38	MET SPELL	3	53.395	0.696	177	9.261	33.000	71.000
39	MET LG USE	3	51.079	0.546	177	7.268	28.000	73.000
40	MET LG PUNC	3	48.785	0.598	177	7.953	28.000	71.000
41	MET LG TOT	3	49.729	0.603	177	8.017	29.000	69.000
42	MET AR COMP	3	46.836	0.755	177	10.045	28.000	76.000
43	MET AR SOLV	3	47.870	0.795	177	10.571	20.000	73.000
44	ARTIC TOT	3	0.757	0.142	177	1.896	0.	14.000
45	BENDER	1	2.034	0.144	177	1.921	0.	11.000
46	L-T IQ	1	107.766	1.148	175	15.184	70.000	148.000

SAMPLE SIZE = 177

TABLE 12.

SCHOOL ACHIEVEMENT AS RELATED TO DEVELOPMENTAL SPEECH INACCURACY
TOTAL GROUP CORRELATIONS -- VARIABLES FOR ALL YEARS

CORRELATION COEFFICIENTS TIMES 1000*		1 CA 1	2 PBDY IQ 1	3 AUD DISC1	4 AUD MEM1	5 VIS MEM1	6 VIS DISC1	7 MOT MOV1	8 L-T IQ 1	9 MET TOT1	10 ARTIC TOT1
1 CA	1	1000									
2 PBDY IQ	1	-162	1000								
3 AUD DISC	1	-161	-290	1000							
4 AUD MEM	1	34	120	-160	1000						
5 VIS MEM	1	-90	-120	180	-134	1000					
6 VIS DISC	1	-74	-106	218	-193	333	1000				
7 MOT MOV	1	121	122	-65	80	-49	-35	1000			
8 L-T IQ	1	2	451	-240	101	-44	-167	175	1000		
9 MET TOT	1	282	293	-321	309	-194	-209	116	308	1000	
10 ARTIC TOT	1	-91	-186	192	-125	22	-14	-100	-82	-219	1000
11 BENDER	1	-69	-223	203	-203	231	183	-117	-208	-559	168
12 CA	2	862	-144	-99	39	-146	-54	160	-54	271	-104
13 PBDY IQ	2	69	572	-252	166	-44	-149	217	462	381	-189
14 AUD DISC	2	-89	-145	95	-8	71	201	-114	-193	-198	188
15 AUD MEM	2	0	48	-121	322	-158	-154	-3	64	249	-34
16 VIS MEM9	2	-69	-197	230	-91	159	173	-49	-156	-411	173
17 VIS DIS9	2	-138	-175	186	-93	38	115	28	-106	-291	236
18 MOT MOV MEAN	2	47	263	-108	154	-64	-151	165	200	151	-206
19 MET WD KNOW	2	128	308	-272	257	-219	-268	63	316	507	-205
20 MET WD DISC	2	156	207	-310	281	-240	-158	125	265	514	-220
21 MET READ	2	128	279	-284	290	-250	-296	123	383	505	-177
22 MET SPELL	2	122	242	-299	265	-232	-252	125	276	498	-250
23 MET AR SOLV	2	145	370	-326	291	-135	-271	25	408	581	-99
24 MET AR COMP	2	83	101	-254	180	-120	-183	45	216	407	-8
25 MET AR TOT	2	123	294	-324	286	-150	-266	41	371	572	-69
26 ARTIC TOT	2	-75	-98	108	-64	29	57	-137	6	-80	481
27 BENDER	2	-89	-77	189	-94	133	93	-1	-165	-387	160
28 CA	3	874	-169	-103	13	-97	-34	156	-76	241	-131
29 PBDY IQ	3	-23	545	-179	154	-129	-96	126	405	340	-195
30 AUD DISC	3	85	-201	35	-27	1	36	-17	-26	70	208
31 AUD MEM	3	-12	75	-178	322	-192	-64	97	-9	104	-27
32 VIS MEM9	3	-204	-50	198	-205	152	218	5	5	-220	161
33 VIS DIS9	3	-43	-39	101	2	101	251	48	10	-117	39
34 MOT MOV MEAN	3	54	177	-239	185	-109	-171	222	187	205	-150
35 MET WD KNOW	3	45	393	-348	237	-240	-246	131	415	455	-206
36 MET WD DISC	3	99	295	-274	313	-267	-238	150	361	451	-165
37 MET READ	3	42	342	-235	274	-237	-244	138	420	477	-152
38 MET SPELL	3	96	145	-283	304	-270	-244	91	259	437	-186
39 MET LG USE	3	-5	245	-239	271	-132	-205	147	317	366	-108
40 MET LG PUNC	3	171	282	-305	289	-199	-274	70	278	553	-145
41 MET LG TOT	3	114	298	-306	312	-190	-269	115	323	538	-145
42 MET AR COMP	3	21	275	-286	213	-214	-231	43	365	479	-69
43 MET AR SOLV	3	53	336	-291	246	-256	-264	58	432	538	-62
44 ARTIC TOT	3	-75	-168	7	-13	42	7	-67	-57	-100	429
45 BENDER	3	-23	-153	157	-116	87	135	88	-130	-261	-23
46 L-T IQ	3	-146	367	-188	271	-223	-274	45	372	503	-47

SAMPLE SIZE = 177 * for $r \geq .147$, $p \leq .05$

TABLE 12. (continued)

SCHOOL ACHIEVEMENT AS RELATED TO DEVELOPMENTAL SPEECH INACCURACY TOTAL GROUP CORRELATIONS -- VARIABLES FOR ALL YEARS

CORRELATION COEFFICIENTS TIMES 1000*	YR	11 BENDER1	12 CA 2	13 PBDY IQ 2	14 AUD DISC2	15 AUD MEM2	16 VIS MEM9 2	17 VIS DIS9 2	18 MOTMOV MEAN2	19 METWD KNOW2
1 CA	1									
2 PBDY IQ	1									
3 AUD DISC	1									
4 AUD MEM	1									
5 VIS MEM	1									
6 VIS DISC	1									
7 MOT MOV	1									
8 L-T IQ	1									
9 MET TOT	1									
10 ARTIC TOT	1									
11 BENDER	1	1000								
12 CA	2	-73	1000							
13 PBDY IQ	2	-215	-18	1000						
14 AUD DISC	2	153	-65	-214	1000					
15 AUD MEM	2	-166	-8	100	-138	1000				
16 VIS MEM9	2	515	-70	-235	336	-58	1000			
17 VIS DIS9	2	260	-96	-218	261	-91	433	1000		
18 MOT MOV MEAN	2	-199	14	325	-299	88	-343	-290	1000	
19 MET WD KNOW	2	-399	102	362	-274	160	-430	-283	381	1000
20 MET WD DISC	2	-509	121	265	-273	199	-513	-297	312	803
21 MET READ	2	-378	78	353	-277	201	-408	-248	355	867
22 MET SPELL	2	-418	85	313	-279	166	-442	-274	360	858
23 MET AR SOLV	2	-469	77	472	-316	184	-419	-251	272	694
24 MET AR COMP	2	-355	-8	191	-172	224	-289	-170	176	451
25 MET AR TOT	2	-472	34	407	-284	238	-404	-250	255	667
26 ARTIC TOT	2	28	-113	-49	23	-7	1	35	-16	-28
27 BENDER	2	491	-76	-150	189	-50	331	341	-163	-249
28 CA	3	-53	981	-26	-54	-10	-67	-85	6	75
29 PBDY IQ	3	-224	-2	727	-262	82	-220	-191	214	408
30 AUD DISC	3	-111	85	-124	273	-31	3	134	-10	61
31 AUD MEM	3	-118	19	41	-103	247	63	-18	-6	81
32 VIS MEM9	3	204	-179	-118	220	-166	363	412	-157	-332
33 VIS DIS9	3	70	-10	-76	243	-82	225	250	-114	-259
34 MOT MOV MEAN	3	-209	-17	313	-193	119	-280	-71	414	351
35 MET WD KNOW	3	-418	50	453	-272	179	-347	-248	381	811
36 MET WD DISC	3	-393	71	371	-261	182	-341	-227	341	832
37 MET READ	3	-406	13	422	-241	176	-309	-252	357	722
38 MET SPELL	3	-372	48	235	-247	172	-366	-224	316	818
39 MET LG USE	3	-329	-48	321	-228	228	-246	-110	281	622
40 MET LG PUNC	3	-446	84	383	-287	196	-356	-205	310	674
41 MET LG TOT	3	-447	37	397	-284	229	-347	-181	329	720
42 MET AR COMP	3	-467	-8	328	-217	103	-356	-110	181	599
43 MET AR SOLV	3	-523	11	394	-228	178	-387	-203	252	694
44 ARTIC TOT	3	166	-202	-83	6	152	185	113	-186	-138
45 BENDER	3	478	-57	-144	42	-134	274	219	-124	-189
46 L-T IQ	3	-448	-169	378	-145	249	-338	-232	275	664

SAMPLE SIZE = 177   * for $r \geq .147$, $p \leq .05$

TABLE 12. (continued)

SCHOOL ACHIEVEMENT AS RELATED TO DEVELOPMENTAL SPEECH INACCURACY
TOTAL GROUP CORRELATIONS -- VARIABLES FOR ALL YEARS

CORRELATION COEFFICIENTS TIMES 1000 *	YR	20 METWD DISC2	21 MET READ2	22 MET SPELL2	23 METAR SOLV2	24 METAR COMP2	25 METAR TOT2	26 ARTIC TOT2	27 BEN-DER2	28 CA 3
1 CA	1									
2 PBDY IQ	1									
3 AUD DISC	1									
4 AUD MEM	1									
5 VIS MEM	1									
6 VIS DISC	1									
7 MOT MOV	1									
8 L-T IQ	1									
9 MET TOT	1									
10 ARTIC TOT	1									
11 BENDER	1									
12 CA	2									
13 PBDY IQ	2									
14 AUD DISC	2									
15 AUD MEM	2									
16 VIS MEM9	2									
17 VIS DIS9	2									
18 MOT MOV MEAN	2									
19 MET WD KNOW	2									
20 MET WD DISC	2	1000								
21 MET READ	2	792	1000							
22 MET SPELL	2	808	819	1000						
23 MET AR SOLV	2	581	688	652	1000					
24 MET AR COMP	2	469	498	466	564	1000				
25 MET AR TOT	2	603	689	645	914	841	1000			
26 ARTIC TOT	2	-31	-47	-62	-6	-31	-20	1000		
27 BENDER	2	-343	-217	-285	-285	-224	-286	-10	1000	
28 CA	3	101	52	71	69	1	31	-137	-69	1000
29 PBDY IQ	3	299	335	319	435	67	323	-2	-172	-49
30 AUD DISC	3	43	56	84	75	3	50	117	-48	84
31 AUD MEM	3	47	67	115	100	74	96	-189	-43	-5
32 VIS MEM9	3	-377	-308	-315	-302	-302	-347	30	214	-169
33 VIS DIS9	3	-256	-259	-285	-182	-272	-243	101	142	3
34 MOT MOV MEAN	3	339	348	353	308	231	306	-59	-73	12
35 MET WD KNOW	3	719	778	764	630	395	597	-3	-227	-8
36 MET WD DISC	3	787	796	788	591	425	592	-31	-274	22
37 MET READ	3	674	780	713	577	394	568	-14	-232	-42
38 MET SPELL	3	775	781	871	584	474	604	-17	-259	-0
39 MET LG USE	3	532	617	607	421	348	441	-2	-196	-88
40 MET LG PUNC	3	621	690	672	600	448	601	-22	-302	34
41 MET LG TOT	3	649	730	715	589	453	597	-18	-288	-14
42 MET AR COMP	3	589	619	631	677	530	695	38	-370	-46
43 MET AR SOLV	3	692	720	692	731	615	770	47	-354	-30
44 ARTIC TOT	3	-124	-147	-117	-33	63	14	449	66	-197
45 BENDER	3	-273	-213	-178	-291	-252	-300	-96	569	-21
46 L-T IQ	3	598	691	626	636	491	649	46	-265	-221

SAMPLE SIZE = 177 * for $r \geq .147$, $p \leq .05$

TABLE 12. (continued)

SCHOOL ACHIEVEMENT AS RELATED TO DEVELOPMENTAL SPEECH INACCURACY
TOTAL GROUP CORRELATIONS -- VARIABLES FOR ALL YEARS

CORRELATION COEFFICIENTS TIMES 1000*	YR	29 PBDY IQ 3	30 AUD DISC3	31 AUD MEM3	32 VIS MEM9 3	33 VIS DIS9 3	34 MOTMOV MEAN3	35 METWD KNOW3	36 METWD DISC3	37 MET READ3
1 CA	1									
2 PBDY IQ	1									
3 AUD DISC	1									
4 AUD MEM	1									
5 VIS MEM	1									
6 VIS DISC	1									
7 MOT MOV	1									
8 L-T IQ	1									
9 MET TOT	1									
10 ARTIC TOT	1									
11 BENDER	1									
12 CA	2									
13 PBDY IQ	2									
14 AUD DISC	2									
15 AUD MEM	2									
16 VIS MEM9	2									
17 VIS DIS9	2									
18 MOT MOV MEAN	2									
19 MET WD KNOW	2									
20 MET WD DISC	2									
21 MET READ	2									
22 MET SPELL	2									
23 MET AR SOLV	2									
24 MET AR COMP	2									
25 MET AR TOT	2									
26 ARTIC TOT	2									
27 BENDER	2									
28 CA	3									
29 PBDY IQ	3	1000								
30 AUD DISC	3	-142	1000							
31 AUD MEM	3	104	-94	1000						
32 VIS MEM9	3	-164	40	-17	1000					
33 VIS DIS9	3	-143	-57	-81	318	1000				
34 MOT MOV MEAN	3	191	-66	104	-150	-91	1000			
35 MET WD KNOW	3	468	20	138	-255	-244	318	1000		
36 MET WD DISC	3	396	9	143	-297	-254	311	841	1000	
37 MET READ	3	440	59	52	-237	-274	268	821	829	1000
38 MET SPELL	3	272	52	161	-272	-308	330	762	850	736
39 MET LG USE	3	305	-17	153	-146	-205	268	672	683	630
40 MET LG PUNC	3	303	-2	85	-260	-188	196	622	670	692
41 MET LG TOT	3	338	-4	125	-235	-214	249	701	741	738
42 MET AR COMP	3	288	120	2	-305	-151	177	589	622	637
43 MET AR SOLV	3	373	89	32	-296	-235	248	716	742	745
44 ARTIC TOT	3	-81	72	-113	-42	-49	28	-114	-86	-97
45 BENDER	3	-80	-144	-13	287	130	-73	-265	-229	-254
46 L-T IQ	3	364	61	83	-238	-268	234	710	717	779

SAMPLE SIZE = 177 * for $r \geq .147$, $p \leq .05$

TABLE 12. (concluded)

SCHOOL ACHIEVEMENT AS RELATED TO DEVELOPMENTAL SPEECH INACCURACY
TOTAL GROUP CORRELATIONS -- VARIABLES FOR ALL YEARS

CORRELATION COEFFICIENTS TIMES 1000*	YR	38 MET SPELL3	39 METLG USE3	40 METLG PUNC3	41 METLG TOT3	42 METAR COMP3	43 METAR SOLV3	44 ARTIC TOT3	45 BEN-DER3	46 L-T IQ 3
1 CA	1									
2 PBDY IQ	1									
3 AUD DISC	1									
4 AUD MEM	1									
5 VIS MEM	1									
6 VIS DISC	1									
7 MOT MOV	1									
8 L-T IQ	1									
9 MET TOT	1									
10 ARTIC TOT	1									
11 BENDER	1									
12 CA	2									
13 PBDY IQ	2									
14 AUD DISC	2									
15 AUD MEM	2									
16 VIS MEM9	2									
17 VIS DIS9	2									
18 MOT MOV MEAN	2									
19 MET WD KNOW	2									
20 MET WD DISC	2									
21 MET READ	2									
22 MET SPELL	2									
23 MET AR SOLV	2									
24 MET AR COMP	2									
25 MET AR TOT	2									
26 ARTIC TOT	2									
27 BENDER	2									
28 CA	3									
29 PBDY IQ	3									
30 AUD DISC	3									
31 AUD MEM	3									
32 VIS MEM9	3									
33 VIS DIS9	3									
34 MOT MOV MEAN	3									
35 MET WD KNOW	3									
36 MET WD DISC	3									
37 MET READ	3									
38 MET SPELL	3	1000								
39 MET LG USE	3	633	1000							
40 MET LG PUNC	3	664	630	1000						
41 MET LG TOT	3	719	840	949	1000					
42 MET AR COMP	3	610	484	674	664	1000				
43 MET AR SOLV	3	694	567	704	720	807	1000			
44 ARTIC TOT	3	-77	-27	-19	-34	38	-50	1000		
45 BENDER	3	-190	-194	-308	-289	-374	-371	32	1000	
46 L-T IQ	3	661	592	671	710	656	752	-3	-314	1000

SAMPLE SIZE = 177 * for r ≥ .147, p ≤ .05

APPENDIX B

EXPERIMENTAL TEST FORMS

Directions for Administrating the Dual Modality Test of Articulation

For the Visual Articulation Test: Show pictures and ask, "Tell me what this is?" If no response, or a word other than the expected one is given, restimulate with another question of the same order. If the response is in a phrase, including the expected word, record as expected word is produced. Where the wrong word is elicited, restimulate to a limit of three times for each picture. Phrase all your questions as briefly as possible. Where a specific question should be asked, it will appear on the back of the picture. Use that question first. Do not repeat the stimulus word for the child. If correct response is not elicited, indicate that desired sound was not tested by scoring N.T. (Not Tested) in appropriate blank. (Unless incorrect response elicits the sound desired, i.e., light for lamp.)

For the Auditory Articulation Test: Be certain that the child is not watching your lips as you frame the test words. Shield your mouth with your hand or a piece of paper or direct the child to look at an object in the room. It is important also that you are in a position to observe the child's mouth as he repeats the words. Test words may be repeated if the child indicates he has not heard the word. This is a test of articulation, not of hearing. Just as there are two pictures for each sound being tested along the visual modality, there are two words for each sound being tested aurally. Test each sound with both of the words before moving on to the next sound.

Scoring Visual and Auditory Tests: Please be consistent in recording sounds. If correct, leave space blank. If sound is omitted, put a dash (-) in the scoring frame. If the sound is distorted or a substitution is made, record according to OUR SOUND KEY, that is, /j/ as in jump, /ch/ as in chair, rather than IPA or other symbols. It will be noted that only initial consonants are tested.

DUAL MODALITY TEST OF ARTICULATION

Name ____________ Sex ______
School or Institution ____________
Grade ______ Clinic # ______

	(year)	(month)	(day)
TEST DATE			
BIRTH DATE			
C.A.			

		VISUAL MODALITY						AUDITORY MODALITY			
No.	SOUND	STIMULUS	RESP	TIME	STIMULUS	RESP	TIME	STIMULUS	RESP	STIMULUS	RESP
1	t	t.v.			table			time		took	
2	d	door			dog			done		day	
3	n	knife			nose *			need		new	
4	m	moon			monkey			my		most	
5	b	baby			bed			big		but	
6	h	house			hammer			how		him	
7	w	wagon			window			wait		wish	
8	p	pencil			pig			pay		pass	
9	k	car			cat			cut		call	
10	f	fork			foot			fine		for	
11	g	gun			gas *			good		get	
12	y	yo-yo			yard *			yet		you	
13	l	leaf			lamp			law		look	
14	sh	shoe			shadow *			should		show	
15	th^{v}	--			--			that		them	
16	v	vacuum			vegetable *			very		visit	
17	s	sun			scissors			same		seem	
18	z	zipper			zebra			zinc		zone	
19	j	giraffe *			jump *			just		job	
20	r	radio			rain *			ride		race	
21	ch	chain			chair			cheese		choose	
22	th	thumb *			three *			think		thank	

Peabody Raw ______
M.A. ______
I.Q. ______
Aud. Dis. ___/30 ___/10
Aud. Memory ______
Bender ______
Vis. Memory ______
Visual Dis. ______
Motor Move. 1. ______
2. ______
3. ______
4. ______
5. ______
Group Test IQ: ______
M.R.R. ______
Diagnostic Category:
______
Examiner:
______

* consult back of stimulus card

AUDITORY MEMORY TEST

NAME: ____________________ AGE: _____ EXAMINER: ____________

DATE: ____________

Consonants Used		Verbatim Response
T	G B	
D	N P	
N	T D K	
M	D G M	
B	K B P N	
P	M G N D	
K	N D K M B	
G	D T M P G	
	K D G N M B	
	M T D P B N	
	D M G P N T B	
	M T G N D B P	
	T D K G M B P N	
	P B M G D K N T	

SCORE____________

1. Each consonant is followed by a Ē.
2. Record each child's responses verbatim.
3. If the child succeeds on the first trial of a series (e.g., T D K), go on to the next series (e.g., K P B N).
4. If the child fails on the first trial of a series (e.g., T D K), the second trial is given (e.g., D G M).
5. If the child fails both trials of a series, discontinue testing.
6. The score is the number of consonants in the longest series correctly reproduced by the child.

VISUAL PERCEPTUAL TEST

Part I

Memory Administration

The directions for administration are as follows: Expose design x-1. Point to the circle and say, "See this design? I want you to look at it carefully because I'll ask you to find it afterwards." Let him look at the design for five seconds. Then turn to the x-1 four-design sheet and say, "Now find it here." If the child does not know what to do or points to an incorrect design, turn back to the single design sheet, point directly to the circle and tell him that this is the design he is to look for on the other sheet. Do this as many times as is necessary. Then turn to design x-2 and say, "Now look at this one." Again the design is exposed for five seconds before the x-2 four-design sheet is shown. Then the same procedure as on x-1 is followed, i.e., the original design is shown again as many times as is necessary to allow him to make the correct choice.

From design A onward the child is again shown the single design sheet for five seconds before the four-design sheet is exposed. However, the child is not allowed to look at the original design again. He is allowed as much time as he needs to make his choice.

With many young children it is necessary to encourage them to continue looking at the model and then to look carefully at the four designs. Such "encouragement" needs to be used judiciously for it can indicate to a child that he has been wrong and serve to discourage him instead. Children who give position responses pose a particular problem (e.g., design B each time). This may be an easy way out for a child who can do better or a measure of inability to handle the task. Probably all one can legitimately do is ask the child to "look carefully", "try to find the right one", but accept what he decides to offer..

Part 2

Matching Administration

The directions for administration are as follows: Expose sheet x-1, point to the model and say, "Find the one that's just like this." Give the child any help he needs to get the idea. Then go on to sheet x-2 and follow the same procedure. From sheet A on, no help is given. If it seems necessary, the child should be encouraged to look carefully. There is no time limit.

CHICAGO MULTIPLE CHOICE ADAPTATION OF THE BENDER-GESTALT

SET____________________ EXAMINER____________________

NAME____________________ AGE______ SEX______ DATE____________

CHOICE

CARD	A	B	C	D
A	✓			
1			✓	
2			✓	
3	✓			
4		✓		
5			✓	
6	✓			
7				✓
8				✓

Comments:

Directions: Place a check (✓) in the box designating the child's choice on the Memory Administration.

Place an (M) in the box for his choice on the Matching Administration.

Directions for Administration of the Oral Motor Movement Test

Explain to the child that you want to find out how fast he can repeat certain words. Tell him that you are going to time him with a watch, "like this", and demonstrate the procedure.

Use the following syllables for practice. Do not time or record these attempts.

1. Pă
2. Tă
3. Kă

Explain further that when these syllables are put together, they sound "like this" and demonstrate PaTaKa. The child may say PaTaKa also.

Begin the test after telling the child that you want him to continue repeating the words until you tell him to stop.

Record on the basic data sheet the number of times the child repeats syllables or phrases in a 5-second timing period.

1. PaTaKa
2. Put Take
3. Bad Dog

APPENDIX C

RELATED MANUSCRIPTS

The Modality Concept -- Including a Statement of the Perceptual and Conceptual Levels of Learning

by

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1967

" The intellectual life of man consists almost wholly in his substitution of a conceptual order for the perceptual order in which his experience originally comes. "

William James
Essays on Radical Empiricism

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In a recent news-letter from a suburban Chicago special education group, the lead article dealt with learning disabilities and mental retardation. A plea was made that the schools recognize that "maturational lags or temporarily arrested development not be confused with low potential." The article continued with the statement that "... of every thousand American school age children, 150 will have learning problems, 30 will be mentally retarded, and 5 will have learning disabilities and mental retardation." (1) Whether the incidence figures quoted are correct or not, we are all concerned about such children, especially those with normal intellectual potential who are underachievers.

Learning theories and learning theorists, whether biologically or environmentally oriented, have most often failed in their treatment of this issue. They have described the learning process as they see it, but have failed to describe the child who must do the learning. They have rarely provided us with data on the evolution of individual differences in learning abilities of children. Literally, they have never given us reasons why, according to their theories, the underachiever underachieves.

The present paper is an attempt to rectify, at least in part, this neglect of a crucial aspect of learning. While it is not the statement of yet another learning theory, it does provide a modus operandi for learning, e.g., how it is achieved, and therefore, why some children do not achieve when it seems as though they should. It also serves as a partial explanation of individual differences in the manner of learning. Through the approach advocated, it is hoped we can gain some greater insights into the problems of the 15% of all school children who are said to be underachieving.

The present paper deals with the initial stages of learning, especially the early steps taken by children as they develop the capacity to utilize their maturing neurological system. It is not intended as a criticism nor as a support of any of the well publicized theories of learning. It is in fact compatible with any or all of them.

The hypothetical model presented as Figure 1. stresses two features of the structural base underlying the learning act. First, it emphasizes the unique modality bound nature of all sensory input signals and all motor output patterns. Second, it elaborates the hierarchical yet interrelated nature of the maturation and development of the neural system. In this regard it parallels what is known of the physiological maturation of the central nervous system. *

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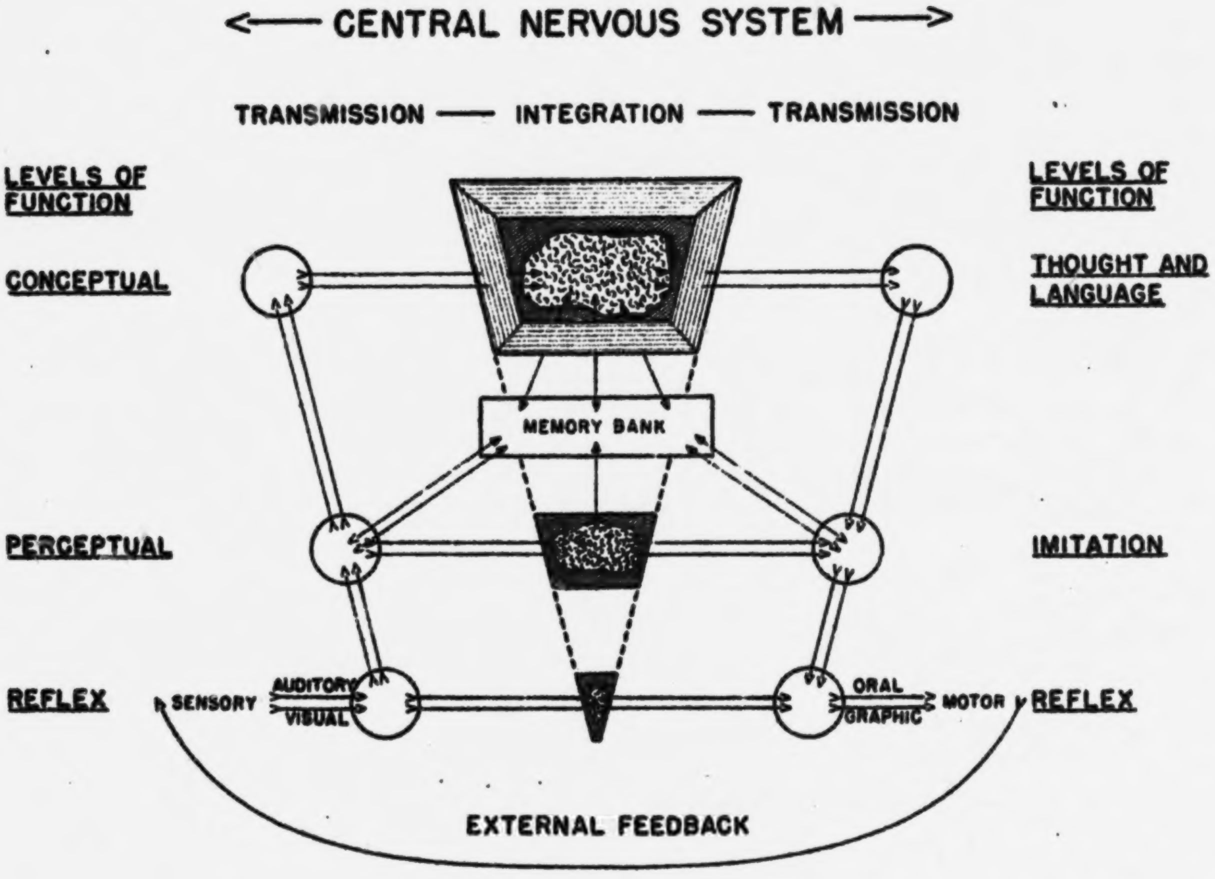
* In the present context, the word 'maturation' is used to describe the establishment of the neurological components necessary for sensory transmission , integration and motor transmission of signals within the nervous system. The term 'development' is reserved for the functional adaptation of an established neural pathway.

Figure 1.


CENTRAL NERVOUS SYSTEM
TRANSMISSION — INTEGRATION — TRANSMISSION
LEVELS OF FUNCTION
LEVELS OF FUNCTION
CONCEPTUAL
THOUGHT AND LANGUAGE
MEMORY BANK
PERCEPTUAL
IMITATION
REFLEX
SENSORY
AUDITORY
VISUAL
ORAL
GRAPHIC
MOTOR
REFLEX
EXTERNAL FEEDBACK

AN OPERATIONAL DIAGRAM OF THE LEVELS OF FUNCTION IN THE CNS

Figure 1. is designed to illustrate both the modality bound nature of the input and output signals and the increasing levels of complexity of function as the individual matures. The modality bound nature of children's learning behavior was initially recognized in the clinically observed fact that many children with learning problems appeared to have greater facility using one input pathway than another and -- an observation of equal importance -- they had considerably less facility along other pathways. This was seen most easily in children with known impairments of neurological structure such as localized brain tumors or accidents affecting, for example, the transmission of auditory signals, but not visual or tactual signals. Similar behavior, however, was seen in some children who had no demonstrable neurological impairment. The learning behavior of this group of children was so similar to the earlier group that even today they are sometimes, erroneously I believe, said to have 'minimal brain impairment'. As more children were studied from this modality viewpoint, it was apparent that a predilection for one sensory input channel over the others could be observed, regardless of whether a suspicion of organic impairment or pathology was present. This seemed in keeping with the concept first suggested by Charcot as reported by Freud (2) that each person has a particular modality of choice in learning, a typology of 'audile', visile', and 'tactile' learners.

Phenomenological data for the division of people into learning types seems to abound in life around us. Toscanini is said to have heard every note of music he read. Picasso, on the other hand, is said to see in his own unique way, even the sounds of animals in the field. People select occupations based upon their predilection for auditory stimuli (musicians) while others pursue the grapic arts (painting) because of their visile-ness.

Clinical data from the handicapped learner or underachiever is equally omnipresent, if one is alerted to it. Some children have been known to be so deficient in auditory processing of signals that for most environmental situations they are functionally deaf even though their hearing acuity is quite normal. One such child was incapable of recalling a telephone number or a single item from a list of ten items read to him. Another could not distinguish the letters of the alphabet at twelve years of age, yet suffered no loss of visual acuity. Studies of adult brain-injured subjects showed with clarity residual ability that was modality bound as they processed verbal stimuli. A factor analytic study of the responses of 168 adult aphasic patients to visual and auditory stimuli on the Language Modalities Test for Aphasia showed "... for all analyses (a single factor) was best defined by all items demanding oral response to visual stimuli, ... while the oral response to auditory stimuli appeared as a separate factor." (3). Still further evidence has been collected from the behavior of a variety of populations which will be reported in some detail during the course of the day's program.

It should be sufficient to say at this time that the concept of differential use of the separate input pathways is no longer purely theoretical but is assuming the proportions of an acceptable fact about children and their learning.

The differential modality distinction appears to be related more closely to the innate capacity of a child than to any determinable environmental factor. No specific deprivation of stimulation could be found in the home or play environments of children with poor auditory learning, poor visual or poor tactile-kinesthetic learning. In fact, within the populations studied clinically, such children have been found to come from all types of homes, including the highly verbal university setting as well as the almost non-verbal disadvantaged environments. They came from homes where they were the only child, and from homes where they were the eldest or youngest of multiple sibling groups.

For most children, the two major modalities seemed to reach a stage of equalization of function by the time they reached their ninth birthday, e.g., whatever lags in development were present seemed to be overcome by that time. Usually, however, the modality showing the most rapid development indicated the child's predilection. Perhaps from this it might be said that a modality matures due to some innate neurological tendency -- for the audile child, the auditory pathway matures soonest; for the visile child, the visual pathway. With maturation, there is an accompanying developmental sequence -- again, the earliest to mature nominates the earlier development of function. The audile child, then, not only matures earliest in an auditory sense, but develops his more mature pathway with the greater ease. Here, use of the pathway assists with its development It comes to complete function and use at an early age. Practically, this would mean that both perceptual and conceptual function would develop early with consequent early and accurate acquisition and use of speech. The visual function of such an 'audile' child could be either rapid or slow in its development. If it is rapid, reading would be accomplished easily, but if it is slow, reading might be delayed somewhat, by the need for compensation to assist the auditory pathway. If the visual were very slow indeed, then reading might present a real block since only the auditory percepts would be available and, while reading is more than a visual skill, it does require vision.

The visile child would pose quite a different problem. If he is average in auditory learning, his reading might be slightly affected in the early school years. If, however, he is markedly slow in auditory perceptual development, only high intelligence providing almost automatic compensation would be helpful, or the services of an alert and patient therapist.

To understand the effect of modality preference on such skills as reading, speech, spelling, et cetera, one must not only be able to isolate the preferred modality, but be able to assess the level of achievement and the potential for training of whatever modality is delayed in its development.

While the emphasis here has been upon the development of visual and auditory pathways, the visuo-motor and moto-kinesthetic pathways need equal attention. In some ways they are perhaps the better attested of the developmentally related modality functions, as Frostig (4) and others have demonstrated.

Attempts to reduce the effect of a lag in developmental progression in any one of the modalities has been somewhat equivocal. Auditory training for children with slow development of such processes as discrimination, memory and sequencing along that modality has produced good results in some children, and failed to produce results in others. These are clinical data, however, and should be studied under the more rigorous analyses of research. For what it is worth, however, those children with poor auditory discrimination who showed what was believed to be causally related speech articulatory inaccuracy failed to improve in auditory discrimination with directed training. On the other hand, children with inadequate auditory discrimination who had difficulty learning to read, again with supposed causal relationships, did indeed improve in discrimination with training.

The major importance of the modality distinction, lies in the direction that it may give for assisting the underachiever. Too often the remedial reading teacher follows the same pattern in remedial work that the classroom teacher follows in general instruction. We have long assumed that a particular method or pattern for teaching or remediating the art or skill of reading was appropriate -- whatever that method might be. The concept of differential modality proclivity would argue for tailoring the instruction and the remediation, especially the latter, to the capacity of the individual child. To illustrate the problems that arise when this is not done: consider the child who has an inadequate auditory perceptual ability as demonstrated by his incapacity to differentiate the sounds of the language, retain and recall them, sequence them properly, or associate them with previously learned visual or tactual-kinesthetic clues, when he is faced by an instructional or remedial program based on the learning of phonics. Consider, oppositely, the child who demonstrates a slower progression of his visual skills than is expected of him, who is faced by a school system approach that fosters sight training. In either instance the failure to recognize the differential modality distinctions for these children almost fore-dooms them to failure in achievement of reading. While this may affect in a major sense only a minimum of the children who are underachievers, it may be partially at the base of a wide variety of other problems engendered by the original failure. Perhaps the entire thesis of the argument for considering the modality distinction can be most succinctly stated as providing a way of understanding the underachiever. If indeed he can be seen as a child who is underachieving because of some real modality distinction, then programs can, and I believe will, be developed that will be of assistance to him.

To this date, attempts to predict reading problems from results on prior perceptual testing has been less than rewarding. While it is true that a greater number of children with poor reading achievement showed poor visual discrimination and memory as well as poor auditory discrimination and memory, the number of false positives has made the prediction an unlikely one. However, at the time when poor reading achievement can be identified, the presence of poor visual or auditory perception can point the way to directed remediation.

The second important aspect of the model presented as Figure 1. is the time-bound progression of the neural system building each succeeding layer upon previously developed layers both in the sense of maturation and development. The infant begins life with a mature and well developed reflex system which soon differentiates into a bridge permitting the flow of environmentally induced signals which proceed from input through integration to output. At this stage, psychologically, only recognition is achieved, but not comprehension. At this level of behavior, the child learns to imitate and echo his environment. He learns to discriminate the sounds of the language he hears and later to differentiate the letters and other forms that he sees. Finally, he develops his highest level of neural behavior -- he receives, integrates and expresses signals from a variety of modalities with comprehension of the input, synthesizes and associates the interpreted signal with previous learning, and formulates an output signal with intent to communicate.

Two kinds of learning, then, are evident -- the perceptual, pre-linguistic pre-operational learning described most completely by Piaget and his followers as 'sensory-motor learning', and the more complex, conceptualizing type of learning with comprehension and intent. Attention in this paper is directed to the former, not because it is felt that this is the more important of the two, but because it seems that there has been overemphasis on the latter for beginning learners of any new skill. This overemphasis has led to a tendency to focus on the child's attack on new learning at the conceptual level, frequently before the child has established a proper perceptual base for that learning. Werner and Kaplan (6) in their study of symbol formation, pointed out that "...a fuller psychological insight into all representation, including linguistic, will be obtained only by operating on the assumption that linguistic representation emerges from and is rooted in non-linguistic forms of representation."

The child having difficulty learning to read, it is here argued, may well be started at too high a level for him if comprehension is demanded before he has mastered the pre-verbal perceptual distinctions necessary for phonic interpolations. The development of the maturing perceptual level can be seen in the progressive achievement of such skills as discrimination, retention and recall of sounds and letters, sequential ordering of phonemes and graphemes, and the ability to interrelated one with the other.

To illustrate what it is the child must learn and be able to use at this pre-comprehension level of behavior, let us explore in some detail the act of auditory discrimination. This auditory perceptual function is the ability to differentiate each sound of the language from every other sound of the language;

at its grossest level, for example, the ability to separate vowels from consonants, then vowels from other vowels, and finally, consonants from other consonants. Vowel discriminations are, for the most part, well accomplished by all but a handful of children by the end of the third year, yet all of us experience some difficulty discriminating certain vowels from others, when spoken -- did he say /pen/ or /pin/ ? is a common adult question, when the context does not provide a satisfactory clue. The difference between the /e/ and /i/ when used medially in a single syllable word is a minimal contrast of considerable difficulty. The distinctions between some consonants is equally difficult -- /p/ and /b/ for example cannot be considered as within the differential speaking armamentarium of the child until he can listen to word pairs like /pat/ and /bat/, and /pin/ and /bin/, and recognize them as being different. The linguistic term for this recognition of difference is called the method of "minimal contrasts" (7). A growing body of research now points to the fact that this ability to form minimal contrasts is a developing process that goes on quite normally in children through their eighth year of life. Some children develop the ability early in life -- their speech efforts reflect this early development. They speak accurately almost from the onset. They have the 'ear' to guide their speech attempts. Other children, however, develop this discriminatory ability more slowly and their speech accuracy often mirrors their development. Some children have difficulty with auditory discrimination throughout their lives, and learn to speak with accuracy only by compensatory means.

Turning back to what has been said about Charcot's concept of learning typology mentioned earlier, the child with good intelligence but slow in development of auditory discrimination ability would undoubtedly need to be thought of as a 'visile' child, or perhaps 'tactile' in his learning, while the child who speaks early and accurately, but later shows some difficulty acquiring the distinctions necessary for differentiating visual forms would most probably be 'audile' or 'tactile'. Some children, of course, will be found who are slow at developing any of their perceptual skills, regardless of the modality involved. These would need to be classified as mentally retarded since they would have no avenue open to them for learning -- and after all, that is what we mean by mental retardation -- the inability to learn.

Stress needs to be placed in initial stages of learning, on this perceptual level, or the later learning at the conceptual level may be faulty and without a basic structure upon which the child can develop his linguistic skills. Where a lag in the developmental process along any of the modalities can be determined, the remedial task seems most properly directed at that modality -- yet if success cannot be achieved through such a direct approach, the teacher should not hesitate to turn to the other modalities, since reading - like speech or writing or spelling - cannot be considered the product of any single modality but rather a confluence of them all. It is believed that this generalized attack through parallel alphabets is the source of the success achieved with such teaching approaches as the Initial Teaching Alphabet (8) which takes advantage of a common alphabet of sounds and letters. Similarly, the Illinois Test of Psycholinguistic Abilities (9) develops with considerable acumen the modality differential in language acquisition, especially at the conceptual level.

No brief is held here for or against any specific teaching method. It is believed that any method can be adapted to the purposes of modality distinctions or reduced to the level of perceptual function, if that is needed. Every teacher and therapist whose unlikely task it is to make every child literate must, at this time at least, be ingenious enough to provide the materials necessary for such teaching. Unless my estimate of the commercial adjuncts to reading is in error, however, and unless the proposed approach to underachievement turns out to be totally unsuccessful, materials will be produced in great abundance.

The paper stresses two factors -- the difference among children in their use of specific modalities for learning, and the necessary establishment of perceptual bases for conceptual learning. It is hoped that at least for the child in need of remediation, education can take on the nature of a child-centered program, and shift away from our ready acceptance of automatization and conformity. While we speak of education in the mass sense, it is the individual child who must learn. It is for his good that the ideas here proposed have been formulated.

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Auditory Modality--Research and Practice

III Modality Approach to Reading Problems

Visual and Auditory Modalities

The purpose of this paper is to discuss and attempt to clarify the role of auditory perception, in particular the two functions of auditory discrimination and auditory memory in the process of learning to read. These functions, it is held here, are contributing factors of more than passing importance to the success or failure of children in a normal classroom and should be more widely recognized as such. A complete definition and interpretation of auditory perception and the role it plays in the modality concept of learning is discussed elsewhere in this publication (12). For present clarification, however, auditory discrimination is the ability to differentiate between closely related speech sounds. Auditory memory is the ability to retain and recall these sounds. An important aspect of this definition should be kept in mind. Auditory discrimination and auditory memory in the present framework are referred to as perceptual qualities and are regarded as a part of the sensory aural input pathway that contributes as a foundation for the conceptual level of learning, and not to sensation plus meaning as is sometimes found in other contexts.

In linguists' terminology, reading is decoding. It corresponds, in process, to listening. In fact, according to Carroll (2), there are two distinct stages specific to the early reading process. The child first learns that the symbols that appear on a printed page represent and correspond to his spoken language. In other words, the initial stage of reading consists of decoding orthography into previously learned speech patterns. The second stage involves comprehension through arousal of associations to effect a meaningful state derived from past verbal learning. The ability to discriminate fine differences in speech sounds, to retain and to recall them facilitates the phonological development in very young children, language acquisition and articulation accuracy. It follows a rather natural logic that these abilities would aid in the decoding--the translation of written material.

Since the early 1930's auditory discrimination and memory abilities have been the subject of much study relative to speech development as well as to reading. In some instances inter-correlations have been sought between the four factors. Such studies have revealed that auditory perceptual abilities are related to success in beginning reading. It is understood from these studies that 1) there is a consistent increase in sound discrimination ability with age; 2) children vary in the rate of development of both auditory discrimination and auditory memory; 3) the development of auditory discrimination and auditory memory has not reached fruition in some children until the ninth year; 4) the auditory measures are not in themselves predictors of success or failure in reading.

Wepman has studied auditory perception and the relation it holds to speech and reading in young children. He has drawn similar conclusions from his studies as those cited above and has offered a detailed theoretical analysis pertaining to these conclusions (7, 8, 9, 10, 11, 12). In addition to those four points, the Wepman focus has been on the significant fact that whether children have a speech defect or not, those who have inadequate auditory discrimination are more likely to be poor readers than the total group. In discussing the implications of his research and the findings of others, Wepman argues that children should be studied as they reach school age to determine whether their auditory abilities have developed to the level that they can benefit from phonic instruction. Unless this is done, Wepman feels that it would be a continuing erroneous practice to approach all children as though they can learn equally well through the same modality. He suggested grouping of children according to modality ability for learning as determined by early assessment.

It is somewhat ironic that as long ago as 1935, Bond cited evidence from his inquiry into the same area that led him to a similar recommendation.

Even in light of the established features that are now known regarding auditory discrimination and memory and their relationship to reading ability, however, inquiry continues along the same line. It appears that these similar researches are not executed as replications of previous studies but as if further probing might produce insights that would strengthen the already known positive relationships and provide a more definite, less complex solution to the problem for those concerned with the teaching of reading. This type of solution to the problem has not been forthcoming, however, and it seems appropriate to explore the meaning of this situation. It is felt by this writer that auditory discrimination and memory are but one set of factors that may contribute to the success or failure of children in beginning reading instruction.

Virtually absent in the literature are longitudinal studies of normal populations and experimental populations which would put into better perspective the overall implications of the role of the auditory measures in learning to read, for that matter, in school achievement in general.

In an effort in part to address this particular issue we have conducted a longitudinal study of a normal school population. The study was begun in 1963. The children were initially tested upon entering first grade, then at the end of second grade and again upon completion of third grade. There were 177 children who were present for the entire three year period. The parameters of the overall study included articulation, intelligence, auditory and visual perception, oral motor movement, visual motor ability and reading readiness measured upon the completion of kindergarten to be compared with later achievement testing.

The specific tests that were used which pertain to this report were the Wepman Auditory Discrimination Test (7) and an experimental test for auditory memory using consonant-vowel nonsense syllables. Experimental tests for visual memory and discrimination that incorporate the use of geometric forms (6) were utilized and further refined. In addition, the Lorge-Thorndike Group Intelligence Tests (3) and the Metropolitan Readiness and Achievement Tests (4) for the appropriate grade levels were given.

Although the final report of this longitudinal study is as yet forthcoming, we have arrived at some interesting empirical corroboration for the theoretical considerations which have been previously discussed. Table 1, for example, shows the mean differences in auditory perceptual ability between scores at the first and the third grade levels. The *t* test shows that this difference is significant ($p < .01$). The same table also shows the mean differences in visual perceptual ability between scores at the first and the third grade levels. These differences are also significant ($p < .01$). Thus the notion of a developmental progression--an improvement--in perceptual ability is again confirmed in the performances of this population in the first three years of school. It should be noted, too, that correlations of improvement in the auditory modality with improvement in the visual modality are low, which means that children who improve in one modality may or may not improve in the other. In other words, the study has shown that perceptual abilities develop significantly in the first three years of school in a normal population and that these abilities progress individually along lines of modality preference at differing rates in the same individual.

Turning now to another factor addressed by the present study, Table 2 shows the relationship between auditory perceptual ability at the beginning of first grade and school achievement, as measured by the Metropolitan Achievement Test subtests at the end of the third grade. Auditory perceptual abilities (discrimination and memory) are significantly correlated with every subtest of the achievement battery ($p < .01$). It can be seen then that auditory perceptual difficulties that exist at the beginning of school may contribute somewhat to the level of school achievement for as long as three years. Table 3 shows the relationship of the visual perceptual abilities (discrimination and memory) at the beginning of grade 1 to the same subtests of the Metropolitan Achievement Test, measured at the end of grade 3. Both of these factors are significantly correlated with most of the subtests ($p < .01$). The exceptions are visual memory and the two subtests, Punctuation and Language Total ($p < .05$). Visual memory and language usage have no significant correlation. The effect of early perceptual difficulties on achievement beyond the third grade is not tested as yet. However a continuation of the present study is now in progress and should clarify this issue.

Conclusions

The findings of the present study support those theoretical considerations of the modality concept of learning to which it was addressed. That perception is a developing process in children into the early school years is not being argued. The emphasis here is twofold. First is the consideration of the effect that this phenomenon of development may have on the child as he enters first grade. Correlations such as the ones presented here that demonstrate significant relationships between first grade perceptual ability and third yeard achievement cannot be overlooked. The stage of development in the various modalities, the adequacy of this development to support the learning that is necessary in the early grades is of crucial importance to successful achievement in the early grades.

The second consideration concerns specific recommendations which seem appropriate in dealing with all children entering first grade. These recommendations follow the theoretical concepts mentioned earlier that are supported by the empirical findings presented here. In first, second, and third grades in any elementary school, most children learn the three "R's" by whatever methods are utilized. However, in every class will be a percentage of children who learn more slowly than do their peers. The complexity of the learning process does not allow full discussion here of all of the possible factors that go to make up the slow learner. However, it would appear from the results of the present study that one strong possibility contributing to this condition, one that can be assessed quite readily is the adequacy of the auditory perceptual ability of first graders. For the purposes of individual maximum potential education, ability grouping on the basis of modality preference as shown by the test results would seem in order.

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Table 1

PERCEPTUAL MODALITY ACHIEVEMENT

Mean Differences Between Scores at First and Third Grade Levels

Test	N	Mean Score Difference (improvement)	Standard Error	t
Auditory Discrimination	172	3.436	0.412	8.34*
Auditory Memory	177	-.305	0.076	-4.01*
Visual Discrimination	177	2.424	0.130	18.65*
Visual Memory	177	2.797	0.150	18.65*

* Significant at .01 level

Correlations of Difference Scores of Auditory and Visual Perceptual Achievement

	Auditory Discrimination	Auditory Memory	Visual Discrimination	Visual Memory
Auditory Discrimination	1.000			
Auditory Memory	-.026	1.000		
Visual Discrimination	.108	-.163	1.000	
Visual Memory	.010	.149	.197	1.000

Table 2

CORRELATION OF AUDITORY PERCEPTUAL ABILITY (FIRST YEAR) AND SCHOOL ACHIEVEMENT (THIRD YEAR)

N = 177

	First Grade Scores	
	Auditory Discrimination	Auditory Memory
Metropolitan Third Grade Achievement		
Word Knowledge	.348**	.237**
Word Discrimination	.274**	.313**
Reading	.235**	.274**
Spelling	.283**	.304**
Language Usage	.239**	.271**
Punctuation	.305**	.289**
Language Total	.306**	.312**
Arithmetic, Computation	.286**	.213**
Arithmetic, Problem Solving	.291**	.246**

** Significant at .01 level

Table 3

VISUAL PERCEPTUAL FACTORS CORRELATED WITH SCHOOL ACHIEVEMENT

N = 177

	First Grade Scores	
	Visual Discrimination	Visual Memory
Metropolitan Third Grade Achievement		
Word Knowledge	.246**	.240**
Word Discrimination	.238**	.267**
Reading	.244**	.237**
Spelling	.244**	.270**
Language Usage	.205**	.132
Punctuation	.274**	.199**
Language Total	.269**	.190*
Arithmetic, Computation	.231**	.214**
Arithmetic, Problem Solving	.264**	.256**

* Significant at .05 level

** Significant at .01 level